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OUTLINES

OF

BOTANY,

TAKEN CHIEFLY FROM

SMITH'S INTRODUCTION;

CONTAINING

AN EXPLANATION OF BOTANICAL TERMS

AND

AN ILLUSTRATION OF THE SYSTEM OF LINNÆUS.

ALSO

SOME ACCOUNT OF NATURAL ORDERS,

AND THE

ANATOMY AND PHYSIOLOGY OF VEGETABLES.

Illustrated by Engravings.

For the use of Schools and Studen

BY DR. JOHN LOCKE,

LECTURER ON BOTANY.

BOSTON:

CUMMINGS AN

For the Author.

1819.

DISTRICT OF MASSACHUSETTS, TO WIT:

District Clerk's Office.

BE IT REMEMBERED, That on the twenty ninth day of July, A. D. 1
and in the forty fourth year of the Independence of the United States of Amer
John Locke of the said District has deposited in this office the title of a Book,
right whereof he claims as author, in the words following, viz.

Outlines of Botany, taken chiefly from Smith's Introduction; containing an
planation of Botanical Terms, and an Illustration of the System of Linnæus.
some Account of Natural Orders, and the Anatomy and Physiology of Vegeta
Illustrated by Engravings. For the use of Schools and Students. By Dr.
Locke, Lecturer on Botany.

In conformity to the Act of the Congress of the United States, entitled, "
Act for the encouragement of learning by securing the copies of Maps, Charts,
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Charts, and Books, to the Authors and Proprietors of such copies, during
times therein mentioned; and extending the benefits thereof to the Arts of
signing, Engraving and Etching Historical and other Prints."

JNO. W. DAVIS,

TO

JACOB BIGELOW, M. D.

Rumford Professor and Lecturer on Materia Medica and Botany in Harvard University.

SIR,

As this little treatise is chiefly taken from a work which has been made particularly valuable to our local situation by your additions, and as the public, especially in this vicinity, are much indebted to your lectures and publications, for a knowledge of the science of Botany, and an acquaintance with our native productions, there is a peculiar propriety in my offering it to your notice.

As you are acquainted with the value of the science, as a branch of early education, I am confident that every effort to put into the hands of the young a facility in its acquisition, will meet your approbation.

Permit me then to place the following pages under your protection, and offer you this inscription as a testimony of personal gratitude and esteem for the honour and benefits of your friendship, which were kindly bestowed on me while your pupil, and have ever since been continued.

Your much obliged friend and

humble servant,

JOHN LOCKE.

Boston, July 24, 1819.

PREFACE.

BOTANICAL works are of two kinds, *elementary* and *practical*. The design of an elementary treatise on botany, is to enable the student by the help of a *practical* work, to find out the name and history of an unknown plant in the most expeditious and certain manner. This it does by making him acquainted, in the first place, with the *marks* or *characters* by which plants are distinguished from each other, such as the forms of the leaves, the number of parts in the flower, &c. and with the terms applied to those characters; and in the second place, with a *system*, by which these characters are used to the best advantage, and a multitude of descriptions so methodized, that the description of an individual can be determined with expedition and certainty.

Practical works contain no explanations of terms or system, but presuming the student to be already acquainted with these, proceed immediately to make use of them in the descriptions of plants.

Elementary works are to practical ones what a spelling-book, dictionary, and grammar are to works of history, poetry, &c. Notwithstanding this distinc-

tion of botanical books is so obvious as seems scarcely to need noticing here, yet I have seen those who were by no means deficient in literature, go to an elementary treatise such as Smith's, and search it in vain for the description of some unknown plant they had met with.

The object of the present treatise has not been to bring forward any thing new in elementary botany, or to alter what has been before established; but merely to collect and arrange the most important "outlines" of the subject in a concise form, and illustrate them by examples of native plants, affording a volume of a moderate price for the use of schools and students.

For several years I have occasionally given instructions in various places, to classes of young people; in several instances to boarding schools of young ladies and misses, who have generally acquired the elements with great facility. In giving these instructions I uniformly felt the want of such a work as this is intended to be. Other instructers informed me that they experienced the same. These were the circumstances which induced me to prepare the following pages.

Lately I have delivered lectures on botany in Dartmouth College and to a private class in the Medical Institution of Yale College. The students in both instances were anxious to obtain a concise work containing the most essential elements, as they had scarcely

time to attend to more. I have therefore endeavoured to make this treatise acceptable not only to schools, but to students generally.

As schools are inclined to attend to the classes and orders of Linnæus without much regard to their practical use, I have been particular to give some account of genera and species, and the application of the elements in practice in "finding out an unknown plant." The classes and orders of Linnæus were constructed for no other purpose than to afford a means of arriving at a knowledge of genera and species, and a knowledge of them seems not to be of much consequence unless applied to this purpose.

I have added some observations on natural orders, and put down in a concise way the natural orders of Linnæus, and also some account of the anatomy and physiology of vegetables.

The English terms have been placed first and the Latin included in a parenthesis, after the manner of Thornton's Grammar. The plants mentioned as examples of the various elementary principles, are generally natives or exotics, which are commonly cultivated. In most cases the common English appellation of the plant is put down first and this followed by the proper technical or Latin name in italics, separated by a comma.

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The student very properly inquires what books are most suitable for his purposes. In addition to this or some other elementary work, it is necessary he should have some practical ones, such as Dr. Bigelow's "Plants of Boston," which is particularly recommended in this vicinity; although it describes a part only of the native plants, yet Dr. B's descriptions and observations, added to the generic and specific characters, render it very satisfactory and easy even to those who are but slightly acquainted with the language of botany: or, Mr. Eaton's "Manual of Botany," 2d ed. "containing descriptions of the indigenous plants to the north of Virginia, which are well defined and established; and of the cultivated exotics."

Mr. Nuttall's "Genera of North American plants," is highly recommended.

Richard's Botanical Dictionary, New-Haven translation, is very useful for students.

The student can do very little towards getting any practical knowledge of botany with less books than this or some other elementary work, and either Dr. Bigelow's "Plants of Boston," or Mr. Eaton's "Manual of Botany," as a practical work.

The student should, if possible, examine plants from the very commencement of studying the elements, es-

pecially those which are mentioned as examples, when he can obtain them.

From what little experience I have had in instructing, I cannot recommend to teachers to oblige their pupils to commit any of the following pages formally to memory; in doing which they are by no means certain to get the ideas. But let them read the whole carefully and obtain a general idea of the various parts of a plant, as the roots, trunks, leaves, and especially of the seven parts of the flower and fruit, without making any particular effort to fix in the mind and retain all the more particular terms, which is a thing hardly practicable. Let them get some knowledge also of the classes and orders and the characters by which they are distinguished; and then proceed immediately to examine plants by practical works, agreeably to the *method* pointed out, p. 86. At the same time genera, species and varieties should be attended to. They should have their elementary work by them, and refer immediately by the index to the explanation of any term in the practical work which they do not understand.

If the student is anxious to arrive at a knowledge of the classes and orders as immediately as possible, he may commence with Part III. the fructification, flower and fruit, p. 45. When he has studied this he will be prepared to understand the classes, orders, and

genera. After acquiring an idea of these, he may proceed to study parts I. & II. the roots and herbage, on which principally are founded the characters of the species.

We will just mention some of the recommendations of the science and study of botany.

1. The science of botany is valuable, as medicine, agriculture, and the arts are more or less dependant upon it.

2. The study recommends itself as a "rich source of innocent pleasure." It is pure and elegant, and becomes more and more interesting as it is pursued. It adds a new sense and opens a new source of enjoyment. It is not among the least of its recommendations to the young, that it takes the place of other amusements, which are liable to be useless, pernicious, or even ruinous, serving in this way as a preventive to intemperance and dissipation.

3. The study is profitable to the young especially, as it forms the mind and regulates the modes of thinking. Many gentlemen whose learning and experience have qualified them to judge in subjects of this nature, have expressed an opinion that children are generally too much confined to the study of abstract subjects; subjects entirely mental, which they can with difficulty, if at all, comprehend, and that their minds would be better form-

ed and their rational powers sooner developed by more attention to sensible objects. Dr. Hosack of New-York, in a letter to Mr. Eaton, published in the "Manual of Botany," makes the following observation on this subject—"In early life, before our external senses are completely evolved; when we are, in truth, endeavouring to bring them into exercise and use; it has always appeared to me a very absurd practice in our schools, to occupy children with studies of an abstract nature, and which require faculties to comprehend them, that are not yet unfolded."

The power of methodizing and analyzing a subject so important in all mental operations, is no doubt better acquired by studying natural history, than by any other means.

The vegetable kingdom, as arranged by Linnæus, is a very perfect model of method. The divisions and subdivisions in the system are founded on marks so simple and obvious, that a child will acquire an exact and practical knowledge of it.

When he has thus acquired a knowledge of system and a power of analysis by attending to sensible objects, he is enabled to carry it into abstract operations, in which sensible objects are not concerned.

In the *analysis* of the vegetable kingdom according to the Linnæan system, we pass from generals to particulars, thus: it is first divided into *classes*, classes are divided into *orders*, orders into

genera, and genera into *species*. This is the course commonly adopted in instructing.

In the *synthesis* we ascend from particulars to generals, thus: species unite themselves into *genera*, genera are united into *orders*, and orders into *classes*. This is the order in which discoveries have proceeded. By this analysis and synthesis, it will be seen, that "systematic botany is practical logic."

The advantages of method are mentioned under the word *system*, page 3. The power of method enables one, by dividing and subdividing a complex subject, finally to simplify each portion, so as to bring it perfectly within the power of his comprehension. The power of method is in mental operations, what the lever, screw, &c. are in mechanical ones: by dividing and diminishing the resistance of a given subject to any degree, it brings it finally to be overcome by a given force, however small.

4. The study of nature is acknowledged to be highly important, as it gives us just views of the character of the Supreme Being, and thus tends to make us wiser and better. It is the study of the "elder scripture written by God's own hand."

The evidences of himself which the Creator has impressed on all his works, are so conspicuous in every class of natural objects with which we are conversant, and particularly in those which delight us most, in the objects of every flowery walk, that he who has had his attention once directed to them, must continually observe them, and will acquire a habit of deriving pleasure from their contemplation.

The study of botany is every year becoming more and more attended to by academies and common

schools, and from its recommendations as a study for the young, every encouragement should be afforded.

The increasing attention to the study of natural history is reckoned among the late improvements in education in this country. Professor Silliman makes the following observation on this point in his American Journal of Science. "An extensive cultivation of the physical sciences is peculiar to an advanced state of society, and evinces in a country where they flourish, a highly improved state of the arts, and a great degree of intelligence in the community. To this state of things we are now fast approximating. The ardent curiosity regarding these subjects, already enkindled in the public mind, the very respectable attainments in science which we have already made, and our rapidly augmenting means of information in books, instruments, collections, and teachers, afford ground for the happiest anticipations."

Boston, July 23, 1819.

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OUTLINES OF BOTANY.

INTRODUCTORY DEFINITIONS.

I. *Natural History.*

NATURAL HISTORY is that science which treats of the productions of nature constituting the globe we inhabit, as they come from the hands of the Creator.

It is generally divided into three branches.

1. *Zoology*, which includes all animals.
2. *Botany*, which treats of plants.
3. *Mineralogy*, which includes the unorganized mass of our globe; as earths, rocks, ores, &c.

Observation. 1. These are called the three kingdoms of nature.

2 A fourth branch has been added: *Aerology*, which includes the atmosphere and whatever floats in it

3. Animals are nourished by vegetables, and vegetables by minerals; thus do plants, by taking up unorganized matter from the mineral kingdom and converting it into nutriment for the animal kingdom, form an indispensable link between them.

BOTANY is a word derived from the Greek *Botane* grass. It is applied to that branch of natural science which teaches us the relations, properties, and general economy of the vegetable kingdom, and at the same time by presenting the innumerable individuals of which this kingdom consists in a form of arrangement that brings them easily within the reach of our comprehension, enables us in practice both to designate them by their proper names, and to avail ourselves of what is known concerning their medicinal or economical uses. *Encyc.*

*Distinctions of Vegetables from height, places of growth, &c.**

I. From height and consistence.

1. A tree, (*arbor*) a woody plant, generally rising to a great height and of long life, producing buds in cold climates. Example, Oak, Pine

2. A shrub, (*frutex*) a tree of small size whose young branches generally produce buds. Ex. Lilac, *Syringa.*

3 Under-Shrub, (*suffrutex*) a woody plant which is usually smaller than a shrub, and frequently produces no buds. Ex. Partridge-berry, *Gaultheria.*

4 Herb, (*herba*) of a tender substance which dies down in winter whether its roots be annual or perennial. Ex. Tulip.

Observation. The difference between a tree and a shrub is difficult to define, although obvious enough to the sight in many instances; the trunk of a tree is usually single, of a shrub, more frequently numerous even from the base.

II. Distinctions from the country in which they grow.

1. Exotics, (*exoticæ*) plants introduced from foreign countries.

2. Indigenous, (*indigenæ*) natives of the country in which they grow.

III. Places where they naturally grow.

In trodden places, (*ruderales.*) In fields, (*arvenses.*) Ex. *Veronica arvensis.* In gardens, (*cultæ.*) In or near water, (*aquaticæ*) aquatics. In marshes, (*paludosæ*) Ex. Scirpi. On the borders of rivers, (*littorales*) Ex. Rushes. On the sea-shore, (*maritimæ*) marine. In meadows, (*pratenses.*) On sands, (*arenosæ.*) On plains, (*campestres.*) In hedges, (*dumosæ* or *sepiariæ.*) In woods, (*nemorosæ.*) On mountains, (*montanæ.*) On very high mountains, alpine (*alpinæ.*) So high as to be frequently enveloped in clouds. THORNTON.

Observation. It it remarable that although plants in other situations vary so much, yet the tops of high mountains which are in the "region of the clouds" generally produce the same. Thus the Alpine plants of England, Scotland, Wales, Lapland, Greenland, Switzerland, Siberia, America, &c.; of Olympus, Ararat, the Alps, the Andes, Alleganies, and White Hills, although growing so remote from each other, are all similar. Various zones of altitude have each their peculiar productions; so that the plants serve to indicate the height of their place of growth.

* These distinctions are not essential in the Linnæan system, and are introduced here as a sort of parenthesis for the want of a more appropriate place.

II. *Characters.*

CHARACTERS are the marks or signs by which natural objects are distinguished from each other. The term character in botany is more particularly applied to that set of marks which distinguish any one plant from all others: it is applied also to the marks by which the various divisions of the vegetable kingdom, as the classes and orders, are distinguised.

Characters are taken from the *number*, *figure*, *situation*, *proportion*, and *connexion* of the various parts of a plant. Each individual mark, as the form of the leaf, the number of parts of the flower, &c. is called a SIMPLE CHARACTER.

Observation. The object of the following work is to make the student acquainted with these simple characters which serve as an alphabet of natural letters, by the various combinations of which in each plant, its character, or name, so to speak, is written upon it. This object should be kept in view by the student, otherwise the terms and their definitions will be unmeaning and tiresome.

III. *System.*

SYSTEM, (*systema*) is an arrangement of natural bodies according to assumed characters; for the purpose of aiding the mind and memory in acquiring and retaining a knowledge of them.

The principal advantages of system result from division and subdivision, which enable us to direct our whole attention to a part of a subject, to a part of that part, and so on, without being burthened with things in connexion: and at the same time with the greatest facility to arrange all together so as to constitute one perfect whole.

Many systems of arrangement of vegetables have been, at various times, proposed; but the system of the celebrated Linnæus, being founded on principles which are simple and obvious, and such as are permanent and universal in nature; has had the most general reception.

According to the Linnæan system the vegetable kingdom is divided into CLASSES, ORDERS, GENERA, and SPECIES.

IV. *General Definitions of the Linnæan System.*

NATURAL HISTORY is the science of animals, vegetables and minerals. See p. 1.

BOTANY is that branch of natural history that gives us a knowledge of the vegetable kingdom. See p. 1.

DIVISIONS OF THE VEGETABLE KINGDOM.

I. *Artificial Divisions.*

1. CLASSES are the first great divisions of the vegetable kingdom, founded upon the number, situation, proportion, &c. of the stamens.

2. ORDERS are divisions of the classes, founded upon the number, situation, &c. of the stamens and pistils ;* principally upon the pistils.

II. *Natural Divisions.*

3. GENERA are divisions of the orders into families. (*genera*) not founded particularly upon the stamens and pistils, but upon the natural resmblance the individuals of a family (*genus*) bear to each other. Examples, 1. The family of Roses (*Rosa.*) 2. The family of Violets (*Viola.*) 3. The Lilies (*Lilium.*)

There is always found in the *flower* and *fruit* (*fructificatio*) a mark or character common to all the individuals constituting a genus. This is called the *Generic Character.* Ex. 1. In the family of Buttercups (*Ranunculus*) it is a scale at the base of each flower-leaf (*petal.*) 2. In the Lilies it is a longitudinal groove in each of the petals.

4. SPECIES, (*species*) are the individuals of which a genus consists ; and of course are divisions of the genera. Ex. 1. The red and white Rose are two species

* Parts of the flower to be hereafter defined.

in the genus (*Rosa*) Rose. 2. The blue and white Violet are two species in the genus (*Viola*) Violet. 3. The various species of Lilies, orange, white, &c.

5. VARIETIES, (*varietas*) are only accidental variations in the appearance of the same individual species. Varieties are distinguished from species by being not permanently propagated by seed. Ex. 1. "All apples are but varieties of the same species; because from the seed of the same apple may be produced trees bearing sour, sweet, red, green, large and small apples respectively. But the Quince is a different species, because it cannot be produced from apple seeds."

2. All the different kinds of Potatoes are only varieties of the same species (*solanum tuberosum*); and although they are permanently propagated by the root yet they are all produced promiscuously by the seed.

CLASSES are compared to States.
ORDERS " to Towns or Cities.
GENERA " to Families.
SPECIES " to Individuals.

V. *A Vegetable and its Primary Divisions.*

VEGETABLES, which constitute the second kingdom of nature according to the definition of Linnæus, "grow and live," or they may be described as organic bodies which draw the matter of their nourishment generally from the earth by means of pores or vessels placed on the external surface of their roots.

Primary Divisions.

The primary parts of a vegetable, (*partes primariæ*) are

1. The ROOT, or descending part.

2. The HERBAGE, comprizing every part except the root, flower, and fruit.

3. The FRUCTIFICATION, which consists of the flower and fruit.

Observation. The following matter is arranged according to these divisions.

PART I.

Root, (*Radix.*)

The Root is the descending part of a vegetable which enters the earth or other substance in search of nourishment for the plant.

The Root consists of two parts.

1. Caudex, the body of the root.
2. Radicula, Radicle, the fibre.*

The latter only is necessary, being the part which imbibes nourishment.

Roots are distinguished by their duration, form, &c.

I. *Duration.*

1. Annual, (*annua*) belongs to plants which perish altogether within a year, the species being continued by means of seeds produced. Ex. Barley.

2. Biennial, (*biennis*) such plants as are produced from seed either in the spring, summer, or autumn, and living through the ensuing winter produce flower and fruit the following summer and then die. Ex. Carrot, Radish.

Observation. The term biennial is applied to any plant that is produced one year and flowers another, provided it flowers but once, whether that event takes place the second year as usual, or whether, from unfavourable circumstances, it may happen to be deferred to any future time.

3. Perennial, (*perennis*) such as live and blossom through many succeeding seasons to an indefinite period. Ex. Trees and many herbaceous plants.

Observation. 1. The herbage is often annual while the root is perennial: such plants are notwithstanding termed perennial.

2. The duration of plants is marked by the following signs.

☉ Annual, ♂ Biennial, ♄ Shrubby, 2↓ Perennial.

* The fibres, particularly their extremities which imbibe nourishment, are in every case strictly annual. After the cessation of their functions in autumn and before their reproduction in the spring, is the time to transplant vegetables successfully.

II. *Form, &c.*

1. FIBROUS, (*fibrosa,*) Plate 1, fig. 1. consisting of fibres either simple or branched, which convey nourishment directly to the basis of the stem or leaves. Ex. Many of the grasses, as *Poa annua.*

Observation. This is the most simple in its nature of all roots, and belongs principally to plants that require but a slight support, such as most annual herbs.

2. REPENT, (*repens.*) Pl. 1, fig. 2. A creeping root. A kind of subterraneous stem creeping and branching horizontally and throwing out fibres as it goes. Ex. Mint, (*Mentha.*)

Observation. Plants furnished with a creeping root are multiplied by their roots in such a manner as frequently to occur in beds of greater or less extent.

3. FUSIFORM, (*fusiformis.*) Pl. 1, fig. 3. A spindle-shaped or tapering root, thick at the top and tapering downwards to a point. Ex. Carrot, Parsnip, Radish.

Observation. The fusiform root descends perpendicularly and throws out fibres or radicles from various parts.

4. ABRUPT, (*præmorsus.*) Pl. 1, fig. 4. Appearing as if the end was bitten off. Ex. Devil's bit, *Liatris.* Birdsfoot Violet, *Viola pedata.*

5. TUBEROUS. (*tuberosa.*) Pl. 1, fig. 5. Composed of tubers. It is of many different kinds. The most genuine consists of fleshy knobs various in form, connected by common stalks or fibres, as in the Potatoe, *Solanum tuberosum.*

Species of the Tuberous Root.

1. Twin, (*geminata.*) Pl. 1, fig. 6. Consisting of a pair of globular or oval bodies, tubers. Ex. *Orchis.*

2. Palmate, (*palmata.*) Pl. 1, fig. 7. Divided into blunt lobes like fingers. Ex. *Orchis maculata.*

Observation. " Of these globular or palmate knobs, one produces the herb and flowers of the present year, withering away towards

autumn, and the other is reserved for the following season, while in the mean time a third is produced to succeed the latter."—*Smith.*

3. Fasicular, (*fasicularis.*) Pl. 1, fig. 8. When a large portion of tubers proceed from a common centre shooting forth in an elongated form, as in Peony.—

Observation. 1. The radicles of tubers originate principally from the stalks and the place of their insertion.

2. Tubers are reservoirs of nourishment, moisture, and vital energy.

3. In most cases a tuber is produced one season, lives through the succeeding winter, and dies the next, after having produced the plant and another tuber or parcel of tubers to succeed it. Thus the herbage is *annual*, and the root, strictly speaking, *biennial*, but as it annually reproduces itself and thus is perpetuated, it is termed *perennial.* Ex Potatoe, (*Solanum tuberosum*)

4. The knobs of genuine tuberous roots, such as the potatoe, are studded with buds, in which respect such roots differ essentially from bulbous ones; which last are themselves simple buds and produce their shoots as well as their offsets, either from the centre or from the base.

All perennial roots, which have annual herbage, have buds. The buds in bulbous roots are in the centre, as they are also in many of the spindle-shaped roots In the creeping root they are at its ends; in the tuberous, as has just been observed, scattered over its surface.

6. Bulbous, (*bulbosa*) a fleshy root of a bulbous or globular form.

Species of the Bulbous Root.

1. Solid, (*solida.*) Pl. 1, fig. 9. Of a uniform substance. Ex. Crocus and Tulip.

2. Tunicate. (*tunicata.*) Pl. 1, fig. 10. Composed of concentric layers enveloping one another. Ex. Onion, *Allium.*

3. Scaly, (*squamosa.*) Pl. 1, fig. 11. Consisting of fleshy scales connected only at their base. Ex. White Lily.

Observation 1. The two latter kinds have a very close analogy with leaf buds. They are the reservoirs of the vital powers of the plant during the winter season. They as well as buds contain, in

winter, plants perfect in all their parts in an embryo state; the leaves and the flowers with all their parts may frequently be distinctly dissected out, and the stamens, pistils, &c. counted.

Linnæus arranged both buds and bulbs under the same term, *Hybernaculum*, winter residence.

2 The radicles are generally from the base of bulbous roots, as in the Onion.

7. GRANULATED, (*granulata.*) Pl. 1, fig. 12. Composed of joints or grains. Ex. Wood Sorrel, *Oxalis Acetosella.* White Saxifrage, *Saxifraga granulata.*

Observation 1. It is with roots as with other natural objects, we can apply terms to the most prominent features, while there are so many intermediate points of gradual transition, that we hardly know where to draw the line of distinction. The application of these terms is in many cases arbitrary.

As botanists have in general determined under what head to place the root of every species of plant, we have only to follow them.

2. Specific characters are sometimes taken from the root, and in some cases the specific name also, as Solanum *tuberosum*, Potatoe; Ranunculus *bulbosus*, Bulbous Ranunculus, and Ranunculus *fascicularis*.

PART II.

THE HERBAGE, (*herba.*)

The HERBAGE consists of the Trunk, Leaves, Buds, and Appendages.

CHAP. I.

TRUNK, (*Truncus.*)

Linnæus enumerates seven kinds of Trunks, Stems or Stalks of vegetables, *caulis, culmus, scapus, pedunculus, petiolus, frons, and stipes.*

1. *Stem.*

STEM. (*caulis.*) Pl. 2, fig. 1. Bears or elevates from the root the leaves as well as flowers. Ex. The trunks and branches of all trees and shrubs. A great proportion of herbaceous plants, especially annuals.

The stem is described from its *duration, composition, mode of growth, shape, &c.*

I. *Duration.*

1. HERBACEOUS, (*herbaceus*) annual, and not woody.
2. SUFFRUTICOSE, (*suffruticosus*) belonging to undershrubs.
3. FRUTICOSE, (*fruticosus*) belonging to shrubs.
4. ARBOREOUS, (*arboreus*) belonging to trees.

II. *Composition.*

1. SIMPLE, (*simplex*) without branches. Ex. White Lily.
2. BRANCHED, (*ramosus*) giving out branches as in most plants.
3. TWO-RANKED, (*distichus*) branches spreading in two horizontal directions. Ex. Hemlock tree, *Pinus Canadensis.*

4. FOUR-RANKED, (*brachiatus.*) Pl. 2, fig. 2. When they spread in four directions, crossing each other alternately in pairs. Ex. Common Lilac, *Syringa vulgaris.*

Observation. A common mode of growth in shrubs which have opposite leaves.

5. MUCH-BRANCHED, (*ramosissimus*) repeatedly subdivided into a great many branches without order. Ex. Most Trees.

6. ABRUPTLY-BRANCHED, (*determinate ramosus*) when each branch after terminating in flowers produces a number of fresh branches in a circular order from just below the origin of those flowers. Ex. *Azalea nudiflora.*

7. PROLIFEROUS, (*prolifer*) shooting out new branches from the summits of the former ones. Ex. Pines.

8. VERTICILLATE, (*verticillatus*) giving off its branches at regular intervals in whorls like rays from a centre, as in the White Pine, *Pinus strobus.*

9. DICHOTOMOUS, (*dichotomus.*) Pl. 2, fig. 3. Repeatedly forked. Ex. *Cerastium vulgatum.*

10. PANICULATE, (*paniculatus*) where the branches are many times subdivided. Ex. *Erigeron Canadense,* see *Panicle.*

11. FASTIGIATE, (*fastigiatus*) the stem being terminated by equal branches so as to make a level top. Ex. Yarrow, *Achillea millefolium.*

III. *Mode of Growth.*

1. ERECT, (*erectus*) upright, nearly perpendicular.

2. OBLIQUE, (*obliquus*) visibly turned from the perpendicular line.

3. PROCUMBENT, (*procumbens*) lying on the ground. Ex. Purslane, *Portulacca oleracea.*

4. REPENT, (*repens.*) Pl. 2, fig. 4. Creeping, running on the ground and taking root at certain distances as it goes. Ex. Creeping Crowfoot, *Ranunculus repens.*

5. Ascending, (*ascendens*) ascending obliquely without support.

Observation. From a horizontal direction is gradually curved or bowed upwards.

6. Prostrate, (*prostratus* or *depressus*) when it lies remarkably flat, spreading horizontally over the ground.

7. Reclining, (*reclinatus*) curved towards the ground. Ex. Blackberry. *Rubus.*

8. Radicant, (*radicans*) clinging to any body for support by means of fibres which do not imbibe nourishment. Ex. *Vitis quinquefolia*, common Creeper.

9. Climbing, (*scandens*) either with spiral tendrils for its support, as the Vine, *Vitis*, Passionflower, *Passiflora*; or by adhesive fibres, as in the preceding paragraph.

10. Twining, (*volubilis.*) Pl. 2, fig. 5. Twining in a spiral manner round other plants, either from left to right, supposing the observer in the centre, (with the sun) as the Hop, or from right to left, (against the sun) as *Convolvulus sepium.*

11. Flagelliforme, (*flagelliformis*) resembling a whip-lash.

12. Sarmentose, (*sarmentosus*) trailing; a creeping stem barren of flowers, thrown out from the root for the purpose of increase, giving rise to another plant where it takes root. Ex. Strawberry.

Observation. A sarmentose stem is filiform and almost naked or having only leaves in bunches at the joints or knots where it strikes root.—*Martin.*

It is called a *sarmentum* or a flagellum, a runner. When leafy, it is generally denominated stolo, a sucker, or scyon, as in Bugle, *Ajuga reptans*, and Sweet Violet, *Viola odorata.*—*Smith.*

13. Straight, (*rectus*) as in Lilium.

14. Strictus expresses only a more absolute degree of straightness.

15. Spreading, (*laxus* or *diffusus*) expanding in an open, loose manner.

16. FLEXUOUS, (*flexuosus*) zigzag; forming angles from right to left and from left to right.

17. JOINTED, (*articulatus*) as in the Prickly Pear, *Cactus*.

IV. *Shape.*

1. ROUND, (*teres*) cylindrical.

2. HALF-CYLINDRIC, (*semiteres*) round on one side and flat on the other.

3. COMPRESSED, (*compressus*) more or less flattened on the sides. Ex. *Poa compressa.*

4. TWO-EDGED, (*anceps.*) Ex. *Sisyrinchium anceps.*

The term ANGULAR comprehends the following.

5. TRIANGULAR, (*triangularis*) having three edges. Ex. *Cactus triangularis.*

6. THREE-SIDED, (*triqueter*) having three flat sides.

7. FOUR-CORNERED, (*tetragonus* or *quadrangularis*) square. Ex. Balm.

8. FIVE-SIDED, (*pentagonus* or *quinquangularis*) having five angles and five sides.

Observation. When the number of angles is either variable or more than five, it is usual merely to describe the stem as (*angulosus*) angular, except where the precise number makes a specific difference, as in the genus *Cactus.—Smith.*

V. *Clothing.*

1. NAKED, (*nudus*) entire nakedness, destitute of leaves, hair, prickles, &c.

2. LEAFLESS, (*aphyllus*) without leaves. Ex. *Cactus.*

3. SCALY, (*squamosus*) having scales. Ex. Beech-drops, *Orobanche.*

4. IMBRICATED, (*imbricatus*) covered with scales, so that the stem does not appear. Ex. *Sempervivum*, Houseleek.

5. WINGED, (*alatus*) furnished longitudinally with a membrane which is commonly a prolongation of the base of the leaves. Ex. Thistle.

VI. *Surface.*

1. Smooth, (*glaber*) destitute of hairs, glands, or any particular excrescences.

2. Polished, (*lævis*) the surface being every where equal and smooth.

3. Shining, (*nitidus*) polished; smooth, and shining.

4. Viscid, (*viscidus*) covered with a clammy juice.

5. Warty, (*verrucosus.*) Ex. *Enonymous verrucosus.*

6. Papillose, (*papillosus*) covered with soft tubercles. Ex. Ice plant, *Mesembryanthemum crystallinum.*

7. Scabrous, (*scaber*) rough to the touch, from any little rigid inequalities. Ex. *Centaurea nigra.*

8. Bristly, (*hispidus.*) Ex. Borage, *Borago officinalis.*

9. Hairy, (*hirtus* or *pilosus.*) Ex. Common Cinquefoil, *Potentilla simplex.*

10. Downy, (*tomentosus*) very soft to the touch from soft feeble hairs so interlaced with each other that each hair cannot be separately distinguished.

11. Shaggy, (*villosus*) covered with long soft hairs.

12. Woolly, (*lanatus.*) Ex. Common Mullein, *Verbascum Thapsus.*

13. Hoary, (*incanus*) appearing as if frosted. Ex. Wormwood, *Artemisia absinthium*, and *Atriplex portulacoides;* in the former case from close silky hairs, in the latter from a kind of scaly mealiness.

14. Mealy, (*glaucus*) clothed with fine sea-green mealiness which easily rubs off. Ex. Common Black Raspberry, *Rubus occidentalis.*

15. Striated, (*striatus*) marked with fine parallel longitudinal lines. Ex. *Conium maculatum.*

16. Furrowed. (*sulcatus*) lines somewhat deeper and broader than the last. Ex. Hogweed, *Chenopodium album.*

17. Spotted, (*maculatus.*) Ex. Hemlock, *Conium maculatum.*

The spines and prickles of the stem will be described under Arms of plants.

VII. *Consistence.*

1. SOLID, (*solidus*) of an uniform solid substance.

2. MEDULLARY, (*inanis* or *medullosus*) containing pith, a spongy substance in the centre. Ex. Elder, *Sambucus.*

3. HOLLOW, (*cavus* or *fistulosus.*) Ex. Hemlock, *Conium maculatum.*

Observation. Plants destitute of a stem are called STEMLESS, (*acaules.*) Ex. Early Anemone, *Anemone hepatica.* Dandelion.

2. *Culm.*

CULM, (*culmus.*) Pl. 2, fig. 6. The proper trunk of the grasses, which elevates the leaves, flower, and fruit.—*Linnæus.*

The Culm is denominated

1. WITHOUT KNOTS, (*enodis.*) Ex. Common Rushes. Bulrush, *Juncus effusus.*

2. JOINTED, (*articulatus*) interrupted by joints or knots from space to space, as in most of the grasses.

3. GENICULATE, (*geniculatus*) bent like the knee. Ex. Floating Foxtail grass, *Alopecurus geniculatus.*

Observation. 1. When a culm takes a curved direction, it usually inclines to bend at the joints only, and thus become geniculate.

2. Several of the terms applied to the stem, (*caulis*) are occasionally applied also to the *culm*, such as ASCENDING, ERECT, SOLID, HOLLOW, ROUND, ANGULAR, ROUGH, SMOOTH, &c.

3. The number of angles in the culm sometimes affords a mark to discriminate the species, as in the genus *Eriocaulon.*—*Milne.*

3. *Scape.*

SCAPE, (*scapus.*) Pl. 2, fig. 7. A Stalk. A species of trunk which springs from the root and bears the flower and fruit, but not the leaves. Ex. Dandelion, *Leontodon,* and Marsh Rosemary, *Statice limonium.* In the former the stalk is simple and single flowered; in the latter, subdivided and many flowered.

The Scape is termed

1. SPIRAL, (*spiralis.*) Ex. *Valisneria spiralis.*
2. SCALY, (*squamosus.*) Ex. *Tussilago farfara.*

Observation. 1. Several of the terms defined under the stems, (*caulis,*) are occasionally applied also to the *Scape* as well as to the *Culm.*

2. Plants furnished with a *Scape* come under the head of STEMLESS plants, (*acaules.*) Thus the Daffodil, Dandelion, and many of the Violets are stemless plants.

3. Linnæus has observed, that "a Scape (*scapus*) is only a species of *pedunculus.*" Should the term *scapus* be abandoned, *Pedunculus radicalis,* a RADICAL PEDUNCLE, should be substituted.

4. *Peduncle.*

PEDUNCLE, (*pedunculus*) Flower stalk. A species of trunk bearing the flower and fruit, but not the leaves.

I. *Composition.*

1. SIMPLE, (*simplex*) without division and bearing only one flower. Ex. Three-coloured Violet, *Viola tricolor.*

2. COMPOUND, (*compositus*) having divisions. Ex. Pea.

3. COMMON, (*communis*) not dividing, but bearing many sessile flowers assembled. Ex. Catkins, as of the Alder, Willow, &c.

4. PARTIAL, (*partialis*) the ultimate division of a common peduncle immediately connected with the flower; sometimes called PEDICEL, (*pedicellus.*)

II. *Insertion on the Plant.*

1. CAULINE, (*caulinus*) growing out of the main stem. Ex. Indian shot, *Canna Indica.*

2. RAMOSE, (*rameus*) growing out of a main branch.

3. AXILLARY, (*axillaris*) growing from the angle made by the leaf and stem, or the branch and stem. Ex. Chickweed, *Stellaria media.*

4. EXTRA-AXILLARY, (*extra-axillaris*) placed near the axilla.

5. OPPOSITE THE LEAF, (*oppositifolius.*)

6. BETWEEN THE LEAVES, (*internodis*) proceeding from the intermediate part of a branch between two leaves.

Observation. A mode of insertion very rare.

7. TERMINAL, (*terminalis*) terminating a stem or branch.

8. LATERAL, (*lateralis*) situated on the side of a stem or branch.

9. SOLITARY, (*solitarius*) either single on a plant or only one in the same place.

10. CLUSTERED, (*aggregatus*) when several grow together.

11. SCATTERED, (*sparsi*) dispersed irregularly over the plant. Ex. *Ranunculus scelleratus.*

III. *Number of Flowers.*

1. ONE-FLOWERED, (*uniflorus.*)
2. TWO-FLOWERED, (*biflorus.*)
3. THREE-FLOWERED, (*triflorus.*)
4. MANY-FLOWERED, (*multiflorus.*)

Reference. For the different modes in which flowers are borne and connected on their footstalks, see *Inflorescence.*

Observation. When there is no peduncle, the flower is said to be SESSILE, (*sessilis.*)

IV. *Direction.*

1. FLACCID, (*flaccidus*) so weak and feeble as to hang down by the weight of the flower it supports.

2. DROOPING (*cernuus*) bent at the top so that the flower is inclined to one side or towards the earth, and cannot be placed erect on account of the curvature. Ex. Annual Sunflower.

3. FLEXUOUS, (*flexuosus*) making angles to the right and left. Ex. *Aira flexuosa.*

V. *Form.*

Besides being occasionally ROUND, ANGULAR, &c. the peduncle is termed

1. FILIFORM, (*filiformis*) thread shaped, when it is of slender structure like a thread.

2. ATTENUATED, (*attenuatus*) diminishing insensibly in thickness from the base to the summit.

3. INCRASSATED, (*incrassatus*) thickening at the summit; opposed to the last. Ex. Annual Sunflower, *Helianthus annuus.*

VI. *Length.*

1. SHORT, (*brevis*) very little shorter than the flower.

2. VERY SHORT, (*brevissimus*) much shorter than the flower.

3. EQUAL. (*mediocris*) of the length of the flower.

4. LONG, (*longus*) somewhat longer than the flower.

5. VERY LONG, (*longissimus*) more than twice the length of the flower.—*Thornton.*

Observation. 1. Linnæus very rarely admits any other mensuration than that arising from the respective length and breadth of the parts of a plant compared with each other; of which the above is an example.

2. Instead of using terms like the above, which would be liable to mislead, authors express themselves more fully thus—*Peduncle shorter than the flower—as long as the flower—longer than the flower—twice as long as the flower, &c.*

5. *Petiole.*

PETIOLE, (*petiolus*) Leaf-stalk or Foot-stalk. A species of trunk bearing the leaf only.

Observation. 1. The peduncle and petiole were called by Linnæus *partial* trunks, being placed upon the *general* or *universal* trunk, which proceeds immediately from the root.

2. The petiole is commonly channelled on its upper side. The channel ends in a concavity at the base on the side next the stem, which is termed the AXILLA.

I. *Composition.*

1. SIMPLE, (*simplex*) without divisions.

2. COMPOUND, (*compositus*) when a common petiole gives origin to several PARTIAL PETIOLES, which either support leaflets immediately, or divide into other partial petioles. Ex. Locust, *Robinia*, and Sumach, *Rhus*.

II. *Appendages.*

1. BEARING TENDRILS, (*cirrhifer.*) Ex. Common Pea.

2. WINGED, (*alatus*) furnished on each side with a leafy appendage. Ex. Dwarf Sumach, *Rhus copallinum*.

III. *Form.*

1. ROUND, (*teres.*) Ex. Common Hollyhock.

2. HALF-ROUND, (*semiteres.*) Ex. Yellow Water Lily, *Nymphæa advena*.

3. FLATTENED, (*compressus.*) Ex. Lombardy Poplar, *Populus dilatata*.

4. CLUB-SHAPED, (*clavatus*) growing gradually thicker towards the top. Ex. *Cacalia suaveolens*.

IV. *Direction.*

1. ERECT, (*erectus*) nearly perpendicular.

2. SPREADING, (*patens*) forming an acute angle with the stem.

3. RECURVED, (*recurvatus*) curved downward.

4. CLIMBING, (*scandens*) performing the office of a tendril. Ex. Virgin's bower, *Clematis Virginiana*.

Observation. 1. In length, the petiole is compared with the leaf, as the peduncle is with the flower. See p. 18.

2. Several terms, defined under *caulis*, are occasionally applicable to the leafstalk.

6. *Frond.*

FROND, (*frons.*) Pl. 2, fig. 8. A species of trunk in which the stem, leaf, and fructification are united as in the Ferns, *Filices*.

7. *Stipe.*

STIPE, (*stipes*) is applied to the stem or leafless part supporting a frond, pl. 2, fig. 8, *a.*; to the stalk of a fungus, pl. 2, fig. 9, *a.*; and to the slender thread which in many of the compound flowers, such as the Dandelion, elevates the hairy or feathery crown (*pappus,*) with which the seeds are furnished, and connects with the seed.

CHAP. II.

BUDS.

THE BUD, (*gemma*) contains the essential parts of a plant, covered by scales in order to protect the tender rudiments enclosed during the winter.

Observation. 1. The scales of buds envelop each other closely and enfold the infant plant or branch. Externally they have often an additional guard of gum, resin or woolliness against wet and cold.

2. That buds contain all that is essential to constitute a perfect plant is proved beyond a doubt by producing plants from buds. This is done either by placing them immediately in the earth or by introducing them into the bark of another plant, which last is termed inoculation. So analogous are buds to seeds that some plants, besides seeds, produce a set of buds or bulbs, which are destined to propagate the plant by falling into the earth and vegetating. "Plants considered in analogy to animals may properly enough be reckoned both *oviparous* and *viviparous.* Seeds are the vegetable eggs; buds, living infant plants which renew their species as certainly as the seed."—*Milne.*

3. Buds, together with bulbous roots, which are buds under ground, constitute what Linnæus termed HYBERNACLE, (*hybernaculum*) that is, the winter-quarters of plants. See observation, p. 8.

FOLIATION, (*foliatio.*)

By foliation or vernation (*vernatio**) Linnæus expresses the curious manner in which the leaves are folded or wrapped up in the buds.

* *Vernatio,* the term employed by Linnæus in his later works instead of *foliatio.*—*Milne.*

Observation. 1. Foliation, which is in fact the structure of the leafbud, is not only curious, but affords a means of distinguishing plants in the dormant season.

2. Buds are various in their forms and structure, but very uniform in the same species or even genus.

Various modes of Foliation.

1. CONVOLUTE BUD, (*gemma convoluta.*) Pl. 3, fig. 1. Rolled together. Ex. Many of the grasses.

2. INVOLUTE, (*involuta.*) Pl. 3, fig. 2. Lateral margins rolled spirally inwards on both sides. Ex. Violet.

3. REVOLUTE, (*revoluta.*) Pl. 3, fig. 3. Lateral margins rolled spirally backwards on both sides. Ex. Coltsfoot, *Tussilago*, and some species of Willow.

4. CONDUPLICATE, (*conduplicata.*) Pl. 3, fig. 4. One side of the leaves doubled upon the other at the mid rib. Ex. Beech and Rose.

5. OBVOLUTE, (*obvoluta.*) Pl. 3, fig. 5. When their respective margins alternately embrace the straight margin of the opposite side. Ex. Pink, *Dianthus.*

6. EQUITANT, (*equitantia.*) Pl. 3, fig. 6. Riding; when the sides of the leaves lie parallel and approach in such a manner as that the outer embrace the inner. Ex. *Iris*, *Acorus*, Sedge-grass, *Carex.*

7. PLICATE, (*plicata.*) Pl. 3, fig. 7. Plaited, folded up like a fan. Ex. Maple, Alder, Mallow.

8. IMBRICATE, (*imbricata.*) Pl. 3, fig. 8. Laid over one another like tiles. Ex. *Campanula.*

9. RECLINATE, (*reclinata.*) Leaf reflected downwards toward the petiole. Ex. Monk's-hood, *Aconitum.*

10. CIRCINAL, (*circinalia.*) Pl. 3, fig. 9. Rolled spirally downwards. Ex. Ferns, *Filices.*

Contents of the Bud.

1. FLOWER-BEARING BUD, (*gemma florifera*) a bud containing the rudiments of flowers.

2. LEAF-BEARING, (*foliifera*) containing rudiments of leaves only.

3. LEAF AND FLOWER BEARING, (*foliifera et florifera*) containing the rudiments both of flowers and leaves.

Observation. Buds containing flowers can in general be distinguished by their form, being thicker and less pointed than those containing leaves only.

CHAP. III.

LEAVES, (*folia.*)

THE LEAF, (*folium*) is an organ of vegetables of an expanded form, presenting a much greater surface to the atmosphere than all the other parts of the plant together.

Observation. Leaves are not merely ornamental to plants; they are essential organs of vegetation, performing the functions of respiration, perspiration, and absorption.

Reference. For the anatomy and functions of leaves, see *anatomy* and *physiology*.

Observation. The uses of leaves in the arts, in medicine and as food for animals; the infinite variety and elegance of their forms, their wonderful vascular structure, and their importance to the plant that bears them, are subjects highly deserving attention, but they are foreign to the purpose of this chapter.—*Smith.*

LEAFLESS PLANTS, (*plantæ aphyllæ*) are those in which the leaves are wanting, the surface of the stem performing the necessary functions. Ex. Glasswort, *salicornia.*

The different situations, insertions, forms and surfaces of leaves, which are next to be explained, are of very great use in systematical botany.

I. *Situation and position of Leaves.*

1. RADICAL LEAVES, (*folia radicalia*) are such as spring from the root. Ex. Dandelion.

2. CAULINE, (*caulina*) stem leaves, grow on the stem.

3. RAMEAL, (*ramea*) branch leaves, sometimes differ from those of the main stem, and then require to be

distinguished from them. Ex. *Malampyrum arvense.*

4. ALTERNATE, (*alterna.*) Pl. 4, fig. 1. Stand solitary on the stem or branches spreading in different directions. Ex. Borage, *Borago.*

5. SCATTERED, (*sparsa.*) Pl. 4, fig. 2. Situated irregularly, without any apparent order. Ex. *Lilium bubiferum.*

6. OPPOSITE, (*opposita.*) Pl. 4, fig. 3. Arising from two opposite points on the same stem. Ex. Lilac, *Syringa vulgaris.*

7. CLUSTERED, (*conferta.*) Pl. 4, fig. 4. Crowded together. Ex. *Trientalis Europœa.*

8. BINATE, (*bina*) only two upon a plant or stem. Ex. *Erythronium Americanum,* and Lily of the valley, *Convallaria majalis.*

9. TERNATE, (*terna*) three together.

10. QUATERNATE, (*quaterna*) four together.

11. QUINATE, (*quina*) five together.

12. VERTICILLATE, (*verticillata.*) Pl. 4, fig. 5. Whorled; is used to express several leaves growing in a circle round the stem, without any reference to their precise number. Ex. Wild Lilies, *Lilium Canadense* and *L. Philadelphicum.*

13. FASCICULATE, (*fasciculata.*) Pl. 4, fig. 6. Tufted or bundled together. Ex. Pine, *Pinus.*

14. IMBRICATE, (*imbricata.*) Pl. 4, fig. 7. Lying one over another like tiles upon a house.

15. DECUSSATE, (*decussata.*) Pl. 4, fig. 8. Crossing each other alternately in pairs. Ex. Motherwort, *Leonurus Cardiaca.*

16. TWO-RANKED, (*disticha.*) Pl. 4, fig. 9. Spreading in two directions, and yet not regularly opposite at their insertion. Ex. Hemlock, *Pinus Canadensis.*

17. UNILATERAL, (*secunda.*) Pl. 4, fig. 10. Leaning all to one side. Ex. Many flowered, Solomon's seal, *Convallaria multiflora.*

18. APPRESSED, (*adpressa*) when the leaf takes a

direction parallel to the stem, and touches it in its whole direction. Ex. *Xeranthemum sesamoides.*

19. Vertical, (*verticalia*) perpendicular; both sides at right angles with the horizon, but not quite in contact with the stem. Ex. *Lactuca Scariola.*

20. Erect, (*erecta*) forming a very acute angle with the stem. Ex. Red Cedar, *Juniperus Virginiana.*

21. Spreading, (*patentia*) forming a moderately acute angle with the stem or branch.

22. Horizontal, (*horizontalia* or *patentissima*) spreading in the greatest possible degree.

23. Reclinate, (*reclinata*) inclining downward. Ex. Motherwort, *Leonurus Cardiaca.*

24. Recurved, (*recurva* or *reflexa*) curved backward.

25. Inflexed, (*incurva* or *inflexa*) curved inward.

26. Oblique, (*obliqua*) twisted, so that one part of each leaf is vertical, the other horizontal. Ex. *Fritillaria obliqua.*

27. Resupinate, (*resupinata*) reversed; when the upper surface is turned downward.

28. Depressed, (*depressa*) radical leaves pressed close to the ground. Ex. *Plantago media.*

29. Natant, (*natantia*) floating on the surface of the water. Ex. Water Lilies, *Nymphæa advena* and *odorata.*

30. Submersed, (*submersa, demersa,* or *immersa*) sunk; plunged under water. Ex. *Potamogeton.*

31. Emerged, (*emersa*) raised above the water.

II. *Insertion.*

By insertion is meant the mode in which one part of a plant is connected with another.

1. Petiolate leaves, (*folia petiolata*) leaves on footstalks; are such as are furnished with that organ, whether long or short, simple or compound.

2. Peltate, (*peltata.*) Pl. 4, fig. 11. When the footstalk is inserted into the centre of the leaf, like the

arm of a man holding a shield. Ex. Nasturtium, *Trapæolum majus.*

3. SESSILE, (*sessilia*) are such as spring immediately from the stem, branch or root, without any footstalk.

4. AMPLEXICAUL, (*amplexicaulia.*) Pl. 4, fig. 12. Clasping the stem with their base. Ex. Several of the Asters, as *Aster Novæ-Angliæ* and *A. amplexicaulis.*

5. CONNATE, (*connata.*) Pl. 4, fig. 13. United at their base. Ex. Trumpet Honeysuckle, *Lonicera sempervivens.*

6. PERFOLIATE, (*perfoliata.*) Pl. 4, fig. 14. When the stem runs through the leaf. Ex. *Uvularia perfoliata.*

Observation. The veins or nerves of a leaf will generally determine whether it be a single perfoliate leaf, as in *Uvularia perfoliata*; or double and connate, as occurs in different degrees in the Trumpet Honeysuckle, *Lonicera sempervivens*, in Feverwort, *Triosteum perfoliatum*, and in *Rudbeckia amplexifolia*, where the connexion is slight.—*Prof. Bigelow.*

7. VAGINANT, (*vaginantia.*) Pl. 4, fig. 15. Sheathing the stem or each other. Ex. Most of the grasses. Wheat, *Triticum.*

8. EQUITANT, (*equitantia.*) Pl. 4, fig. 16. Disposed in two opposite rows, and clasping each other by their compressed base. Ex. Fleur-de-luce, *Iris.*

9. DECURRENT, (*decurrentia.*) Pl. 4, fig. 17. Running down the stem or branch in a leafy border or wing. Ex. Many of the Thistles. Mullein, *Verbascum thapsus.*

10. FLOWER-BEARING, (*florifera.*) Pl. 4, fig. 18. When flowers grow out of the disk or margin of the leaf. Ex. *Ruscus aculeatus.*

Leaves considered with respect to their form are either simple or compound.

Simple Leaves.

A SIMPLE LEAF, (*folium simplex*) is one whose foot-stalk is terminated by a single expansion. See pl. 5.

Observation. Whose divisions however deep do not reach the mid-rib. The mid-rib of a leaf is the principal prolongation of the foot-stalk, which usually runs longitudinally through the middle of it.

Simple leaves are either

UNDIVIDED, (*integra*) having no divisions or lobes. Ex. Grasses ; or

LOBED, (*lobata*) divided into segments. Ex. Cranes-bill, *Geranium*, and Crowfoot, *Ranunculus*.

Simple leaves are described by their form, surface, &c.

Reference. For the definition of a compound leaf, see section VIII.

III. *Form.*

1. ORBICULAR LEAF, (*folium orbiculatum.*) Pl. 5, fig. 1. A circular leaf ; having its length and breadth equal.

2. ROUNDISH, (*subrotundum.*) Pl. 5, fig. 2. Approaching to the circular form. Ex. Roundleaved Wintergreen, *Pyrola rotundifolia.*

3. OVATE, (*ovatum.*) Pl. 5, fig. 3. Egg-shaped ; the base round and broader than the extremity.

Observation. A very common form of leaves.

4. OBOVATE, (*obovatum.*) Pl. 5, fig. 4. Ovate, with the broad end uppermost. Ex. *Clethra alnifolia.*

5. ELLIPTICAL, (*ellipticum.*) Pl. 5, fig. 5. Oval ; of the form of an ellipsis, longer than broad, with the curve of both ends equal. Ex. Solomon's Seal, *Convallaria.*

6. OBLONG, (*oblongum*) three or four times longer than broad.

Observation. This term is used with great latitude, and serves chiefly in a character to contrast a leaf which has a variable, or not a very decided form, with others that are precisely round, ovate, linear, &c.

7. SPATULATE, (*spatulatum.*) Pl. 5, fig. 6. Of a roundish figure, tapering into an oblong base. Ex. Marsh rosemary, *Statice Caroliniana.*

8. WEDGE-SHAPED, (*cuneiforme.*) Pl. 5, fig. 8. Broad and abrupt at the summit and tapering down to the base. Ex. Purslane, *Portulacca oleracea.*

9. LANCEOLATE, (*lanceolatum.*) Pl. 5, fig. 7. Of a narrow oblong form tapering towards each end. Ex. Field Plantain, *Plantago lanceolata,* and many Willows.

Observation. A very common form.

10. LINEAR, (*lineare.*) Pl. 5, fig. 9. Narrow with parallel sides. Ex. Most of the grasses.

11. ACEROSE, (*acerosum.*) Pl. 5, fig. 10. Needle-shaped; linear and evergreen, generally acute and rigid. Ex. Pine, Fir, and Juniper.

12. TRIANGULAR, (*triangulare.*) Pl. 5, fig. 11. Having three prominent angles, without any reference to their measurement or direction. Ex. Striped Maple, *Acer striatum.*

13. QUADRANGULAR, (*quadrangulare.*) Pl. 5, fig. 12. With four angles. Ex. Tulip-Tree, *Liriodendron tulipifera.*

14. QUINQUANGULAR, (*quinquangulare.*) Pl. 5, fig. 13. With five angles.

15. DELTOID, (*deltoides.*) Pl. 5, fig. 14. Shaped like the Greek letter Δ, Delta.

Observation. Trowel-shaped, having three angles, of which the terminal one is much farther removed from the base than the lateral one.—*Smith.*

16. RHOMBOID, (*rhombeum.*) Pl. 5, fig. 15. Diamond-shaped. Ex. Purple Trillium, *Trillium erectum.*

17. RENIFORM, (*reniforme.*) Pl. 5, fig. 16. Kidney-shaped; a broad roundish leaf, whose base is hollowed out. Ex. Canada Snake-root, *Asarum Canadense.*

18. CORDATE, (*cordatum.*) Pl. 5, fig. 17. Heart-shaped; ovate, hollowed out at the base. Ex. Sunflower, and many Violets.

19. LUNATE, (*lunatum.*) Pl. 5, fig. 18. Crescent-shaped; like a half-moon, whether the points are directed towards the stalk or from it. Ex. *Passiflora lunata.*

20. SAGITTATE, (*sagittatum.*) Pl. 5, fig. 19. Arrow-shaped; like the head of an arrow. Ex. Arrow-head, *Sagittaria sagittifolia.*

21. HASTATE, (*hastatum.*) Pl. 5, fig. 20. Halbert-shaped; triangular, hollowed out at the base and sides, but with spreading lobes. Ex. Sheep Sorrel, *Rumex acetosella*, and Bitter-sweet, *Solanum dulcamara.*

22. PANDURIFORM, (*panduriforme.*) Pl. 5, fig. 21. Fiddle-shaped; oblong, broad at the two extremities and contracted in the middle. Ex. Some of the leaves of Various-leaved Aster, *Aster diversifolius.*

23. RUNCINATE, (*runcinatum.*) Pl. 5, fig. 22. Lion-toothed; cut into several transverse acute segments, pointing backward. Ex. Dandelion, *Leontodon taraxacum.*

24. LYRATE, (*lyratum.*) Pl. 5, fig. 23. Lyre-shaped; cut into several transverse segments, gradually larger toward the extremity of the leaf, which is rounded. Ex. Water Avens, *Geum Rivale.*

25. CLEFT or CLOVEN, (*fissum.*) Pl. 5, fig. 24. When the margins of the fissures and segments are straight.

Observation. *Bifidum*, two-cleft; *trifidum*, three-cleft; *multifidum*, many-cleft, &c. express the number of segments.

26. LOBED, (*lobatum.*) Pl. 5, fig. 25. When the margins of the segments are rounded. Ex. Early Anemone, *Anemone hepatica.*

Observation. *Bilobatum*, two-lobed; *trilobatum*, three-lobed, &c. according to the number of lobes.

27. SINUATED, (*sinuatum.*) Pl. 6, fig. 1. Cut into rounded or wide openings. Ex. Oak.

28. PARTED, (*partitum.*) Pl. 6, fig. 2. Deeply

divided nearly to the base. Ex. Spotted Geranium, *Geranium maculatum.*

Observation. *Bipartitum*, two-parted; *tripartitum*, three-parted; *multipartitum*, many parted, according to the number of divisions.

29. LACINIATED or JAGGED, (*laciniatum.*) Pl. 6, fig. 3. Cut into numerous irregular portions.

Observation. 1 *Incisum* and *Dissectum*, cut, are nearly synonymous with the last.—*Smith.*

2. It is remarked by Linnæus, that aquatic plants have their lower, and mountainous ones their upper, leaves most divided, by which they better resist the action of the stream in one case, and of the wind in the other.

30. PALMATE, (*palmatum.*) Pl. 6, fig. 4. Hand-shaped; cut into several oblong, nearly equal segments, about half way or rather more toward the base, leaving an entire space like the palm of the hand. Ex. Sweet-gum, *Liquidamber styracifolia.*

31. PINNATIFID, (*pinnatifidum.*) Pl. 6, fig. 5. Cut transversely into several oblong parallel segments.

Observation. Cut, but not to the mid-rib.

32. BIPINNATIFID, (*bipinnatifidum.*) Pl. 6, fig. 6. Doubly pinnatifid; cut into segments as in the last, and the segments cut again. Ex. Roman Wormwood, *Ambrosia elatior*, and *paniculata.*

33. PECTINATE, (*pectinatum.*) Pl. 6, fig. 7. A pinnatifided leaf, whose segments are remarkably narrow like the teeth of a comb.

34. UNEQUAL, (*inæquale.*) Pl. 6, fig. 8. When the two halves of a leaf are unequal in dimensions and their bases not parallel.

IV. *Termination.*

1. TRUNCATED LEAF, (*folium truncatum.*) Pl. 5, fig. 12. Has the extremity cut off, as it were, by a transverse line. Ex. Tulip-tree, *Liriodendron tulipifera.*

2. PREMORSE, (*præmorsum.*) Pl. 6, fig. 9. Jagged-pointed; bitten off, very blunt with various irregular notches.

3. RETUSE, (*retusum.*) Pl. 6, fig. 10. Ending in a broad shallow notch. Ex. *Rumex digynus.*

4. EMARGINATE, (*emarginatum.*) Pl. 6, fig. 11. Having a small acute notch at the summit.

5. OBTUSE, (*obtusum.*) Pl. 5, fig. 2. Blunt; ending in a segment of a circle.

6. ACUTE, (*acutum.*) Pl. 6, fig. 17. Sharp; ending in an acute angle.

Observation. A very common form.

7. ACUMINATE, (*acuminatum.*) Pl. 6, fig. 12. Pointed; having a taper or awl-shaped point. Ex. Sea Club-rush, *Scirpus maritimus.*

8. BLUNT, WITH A SMALL POINT, (*obtusum cum acumine.*) Pl. 6, fig. 13. Ex. Marsh Rosemary, *Statice limonium.*

Observation. The following term, (mucronate,) is sometimes applied to a leaf of this description.

9. MUCRONATE, (*mucronatum* or *cuspidatum.*) Pl. 6, fig. 14. Sharp-pointed; tipped with a rigid spine.

10. CIRROSE, (*cirrosum.*) Pl. 6, fig. 15. Tendrilled.

V. *Margins.*

1. ENTIRE LEAF, (*folium integerrimum.*) Pl. 5, fig. 1. Ex. The various species of Lilies.

Observation. This term is opposed to all kinds of teeth notches or incisions. It regards solely the margin of a leaf, whereas undivided *integrum* respects its whole shape, and has nothing to do with the margin. English writers who translate the one *entire*, and the other *very entire*, are therefore incorrect.—*Smith.*

2. SPINOUS, (*spinosum.*) Pl. 6, fig. 16. Beset with prickles. Ex. Thistles.

3. UNARMED, (*inerme.*) is opposed to spinous.

4. CILIATE, (*ciliatum.*) Pl. 6, fig. 17. Fringed; bordered with soft parallel hairs. Beech tree, *Fagus ferruginea*, and *Xylosteum ciliatum.*

5. CARTILAGINOUS, (*cartilaginum*) hard and horny. Ex. *Saxifraga callosa.*

6. DENTATE, (*dentatum.*) Pl. 6, fig. 18. Toothed; beset with projecting, horizontal, rather distant teeth of its own substance. Ex. Arrow wood, *Viburnum dentatum.*

7. SERRATE, (*serratum.*) Pl. 6, fig. 19. When the teeth are sharp and resemble those of a saw, pointing toward the extremity of the leaf. Ex. Rose.

Observation. Examples of this are frequent.

8. DOUBLY SERRATE, (*duplicato serratum*) having a series of smaller serratures intermixed with the large. Ex. Black Birch, *Betula lenta.*

9. MINUTELY SERRATE, (*serrulatum*) is used when the teeth are very fine.

10. CRENATE, (*crenatum.*) Pl. 6, fig. 20. When the teeth are rounded and not directed toward either end of the leaf. Ground-Ivy, *Glechoma hederacea.*

11. JAGGED, (*erosum.*) Pl. 7, fig. 1. Irregularly cut or notched, especially when otherwise divided besides. Ex. Hogweed, *Chenopodium viride.*

12. REPAND, (*repandum.*) Pl. 7, fig. 2. Wavy; bordered with numerous minute angles and small segments of circles alternately.

13. GLANDULAR. (*glandulosum.*) Ex. Bay-leaved Willow, *Salix pentandria.*

14. REVOLUTE, (*revolutum*) when the margin is turned or rolled backward. Ex. *Kalmia glauca.*

15. INVOLUTE, (*involutum*) the reverse of the preceding.

16. CONDUPLICATE, (*conduplicatum*) folded when the margins are brought together in a parallel direction.

VI. *Surface.*

Terms expressive of different kinds of surface, applying equally to the leaf, and to the stem, have been

already explained, p. 14. To these may be added the following, chiefly appropriated to leaves.

1. DOTTED, (*punctatum*) full of small points hollow and transparent, or having vesicles containing in them an essential oil. Ex. St. John's-wort, *Hypericum perforatum.*

2. WRINKLED, (*rugosum*) when the veins are tighter than the surface between them, causing the latter to swell into little inequalities. Ex. Various species of Sage, *Salvia.*

3. BLISTERY, (*bullatum*) is only a greater degree of the last. Ex. Cabbage, *Brassica oleracea.*

4. PLAITED, (*plicatum.*) Pl. 7, fig. 3. When the disk of the leaf, especially toward the margin, is acutely folded up and down. Ex. *Veratrum viride.*

Observation. Folded like a fan, distinguished from waved by the folds being angular.—*Martyn.*

5. UNDULATE, (*undulatum.*) Pl. 7, fig. 4. Waved; when the disk near the margin is waved obtusely up and down.

6. CURLED, (*crispum.*) Pl. 7, fig. 5. When the border of the leaf becomes more expanded than the disk, so as to grow elegantly curled and twisted. Ex. *Malva crispa*

7. CONCAVE, (*concavum*) hollow; depressed in the middle, owing to a tightness in the border.

8 CONVEX, (*convexum*) opposed to the last.

9. VEINY, (*venosum.*) Pl. 7, fig. 6. When the vessels by which the leaf is nourished are branched and subdivided, and more or less prominent, forming a net-work on either or both its surfaces. Ex. Common Thorn, *Cratægus*, and Pear, *Pyrus.*

10. NERVED, (*nervosum* or *costatum.*) Pl. 7, fig. 7. Ribbed; when they extend in simple lines from the base to the point. Ex. Ladies'-slipper, *Cypripedium.*

11. THREE-NERVED, (*trinerve.*) Pl. 7, fig. 8. Three ribbed; is applied to a leaf that has three ribs, all dis-

tinct, from the very base, as well as unconnected with the margin.

12. Base-three-nerved, (*basi trinerve.*) Pl. 7, fig. 9. Triply-ribbed at the base; is when the base is cut away close to the lateral ribs. Ex. Burdock, *Arctium lappa*, and Sunflower, *Helianthus annuus.*

13. Triply-nerved, (*triplinerve.*) Pl. 7, fig. 10. Triply-ribbed; when a pair of large ribs branch off from the main one above the base.

14. Coloured, (*coloratum*) expresses any colour in a leaf besides green.

15. Variegated, (*variegatum*) is applied to leaves which become irregularly blotched with white or yellow. Ex. Striped Grass, *Arundo colorata.*

16. Naked, (*nudum*) implies that the leaf is destitute of all kinds of clothing or hairiness. Ex. *Orchis.*

VII. *Substance, Configuration, &c.*

1. Cylindrical, (*teres.*) Pl. 7, fig. 11. A solid cylinder.

2. Semicylindrical, (*semicylindriaceum.*) Flat on one side.

3. Subulate, (*subulatum.*) Pl. 7, fig. 12. Awl-shaped; tapering from a thick base to a point. Ex. Saltwort, *Salsola kali.*

4. Tubular, (*tubulosum*) hollow within like a tube. Ex. Common Onion, *Allium Cepa.*

5. Fleshy, (*carnosum*) of a thick pulpy consistence, as in all those called succulent plants. Ex. Live-forever, *Sedum.*

6. Gibbous, (*gibbum*) swelling on one side or both from excessive abundance of pulp.

7. Compressed, (*compressum*) flattened laterally.

8. Depressed, (*depressum*) flattened vertically.

9. Channelled, (*canaliculatum*) having a longitudinal furrow. Ex. Sea Plantain, *Plantago maritima.*

10. CARINATE, (*carinatum*) keeled; when the back is longitudinally prominent.

11. ENSIFORM, (*ensiforme*) sword-shaped; is a two-edged leaf tapering to a point, slightly convex on both surfaces. Ex. Flag or Flower-de-luce, *Iris.*

12. TWO-EDGED, (*anceps.*) Much the same as the last.

13. SCIMITAR-SHAPED, (*acinaciforme.*) Pl 7, fig 14. Compressed, with one thick and straight edge, the other thin and curved. Ex. *Mesembryanthemum acinaciforme.*

14. HATCHET-SHAPED, (*dolabriforme.*) Pl. 7, fig. 13. Compressed with a very prominent dilated keel, and a cylindrical base. Ex. *M. dolabriforme.*

15. THREE-EDGED, (*trigonum.*) Pl. 7, fig. 15. Having three longitudinal sides and as many angles. Ex. *Mesembryanthemum deltoides.*

16. THREE-SIDED, (*triquetrum*) differs from *trigonum* only in being used by Linnæus for a three-sided, awl-shaped leaf. Ex. *M. emarginatum.*

17. FOUR-EDGED, (*tetragonum.*) Pl. 7, fig. 16. Having four prominent angles.

18. TONGUE-SHAPED, (*lingulatum*) of a thick, oblong, blunt figure, generally cartilagineus at the edges. Ex. *Mesembryanthemum linguiforme.*

19. MEMBRANOUS, (*membranaceum*) of a thin, pliable texture. Ex. *Rubus odoratus.*

20. LEATHERY, (*coriaceum*) thick, tough, and somewhat rigid. Ex. *Magnolia grandiflora,* and *Hydrangea hortensis.*

21. EVERGREEN, (*sempervirens*) permanent through one, two, or more winters, so that the branches are never stripped. Ex. Pine, *Pinus,* and Laurel, *Kalmia latifolia.*

22. DECIDUOUS, (*deciduum*) falling off at the approach of winter, as in most of the trees and shrubs of our northern climate.

23. ALIENATED, (*alienatum.*) Pl. 7, fig. 17. When the first leaves of a plant give place to others totally

different from them and from the natural habit of the genus. Ex. Many of the *Mimosæ* of New-Holland.

24. HOODED (*cucullatum.*) Pl. 8, fig. 1. When the edges meet in the lower part and expand in the upper. Ex. Hooded Violet, *Viola cucullata,* and Side-saddle Flower, *Sarracenia.*

Observation. A leaf is said to be hooded, whether the edges unite so as to form a perfect cavity as in *Saracenia;* or whether they simply meet without cohering, as in *Viola cucullata.—Prof. Bigelow.*

25. APPENDAGED, (*appendiculatum.*) Pl. 8, fig. 2. Furnished with an additional organ for some particular purpose not essential to the leaf. Ex. Venus's Fly-trap, *Dionæa muscipula.*

Observation. Each of the leaves of this plant is furnished with a pair of armed irritable lobes, which close upon and pierce or imprison insects whenever they crawl upon it; hence the name of Venus's Fly-trap.

VIII. *Compound Leaves.*

COMPOUND LEAVES, (*folia composita*) consist of two, or any greater number of leaflets; (*foliola*) connected by a *common footstalk.*

Observation 1. Any part is denominated *common,* which includes or sustains several parts similar among themselves.

2. These leaflets or lobes are, themselves, small, simple leaves, and like them vary in form according to distinctions already established.—*Milne.*

3. A compound leaf is distinguished from a branch by this circumstance, that the leaflets do not fall off alone, but are accompanied by the common footstalk.

1. JOINTED LEAF, (*folium articulatum.*) Pl. 8, fig. 3. Is when one leaf grows out of the summit of another with a sort of joint.

2. DIGITATE, (*digitatum.*) Pl. 8, fig. 4. Fingered; when several leaflets proceed from the summit of a common footstalk. Ex. Common Cinquefoil, *Potentilla simplex.*

3. BINATE, (*binatum.*) Pl. 8, fig. 5. Is a fingered leaf, consisting of only two leaflets. Ex. *Zigophyllum.*

4. TERNATE, (*ternatum.*) Pl. 8, fig. 6. Consists of three leaflets. Ex. Clover, *Trifolium.*

5. QUINATE, (*quinatum,*) Pl. 8, fig. 4. Of five leaflets. Ex. *Potentilla simplex.*

6. PINNATE, (*pinnatum.*) Pl. 8, fig. 7. When the common footstalk bears many leaflets on each side. It is of several kinds, as follows:

1. With an odd leaflet, (*cum impari.*) Pl. 8, fig. 7. Ex. Rose, *Rosa*; Elder, *Sambucus*; Sumach, *Rhus.*

2. With a tendril, (*cirrosum.*) Pl. 8, fig. 8. When furnished with a tendril in place of the odd leaflet. Ex. Pea, *Pisum.*

3. Abruptly, (*abruptè.*) Pl. 8, fig. 9. Without either a terminal leaflet or tendril. Ex. Common Sensitive-plant, *Mimosa sensitiva.*

4. Opposite, (*oppositè.*) when the leaflets are opposite in pairs. Ex. Water Parsnip, *Sium angustifolium.* Roses, pl. 8, fig. 7.

5. Alternately, (*alternatim.*) Pl. 8, fig. 10. When they are not directly opposite, but alternate.

6. Interruptedly (*interruptè.*) Pl. 8, fig. 11. When the principal leaflets are arranged alternately, with an intermediate series of smaller ones. *Potentilla anserina.*

7. Jointedly, (*articulatè*) with apparent joints in the common footstalk.

8. Decurrently, (*decursivè*) when the leaflets are decurrent.

9. In a lyrate manner, (*lyrato.*) Pl. 8, fig. 12. Having the terminal leaflet the largest, and the rest gradually smaller, as they approach the base. Ex. Avens, *Geum rivale,* and common Turnip.

10. In a whorled manner, (*verticillate.*) Pl. 8, fig. 13. The leaflets cut into fine divaricate segments embracing the footstalk. Ex. *Sium verticillatum.*

7. AURICLED LEAF, (*auriculatum folium*) is a leaf furnished with a pair of leaflets properly distinct, but occasionally liable to be joined with it.

8. CONJUGATE, (*conjugatum*) yoked; consists of only a pair of leaflets, and is much the same as binate. Ex. *Zygophyllum.*

Observation. Two-yoked, (*bijugum.*) Three-yoked, (*trijugum.*) Four-yoked, (*quadrijugum.*) Many-yoked, (*multijugum,*) &c. express particular numbers of pairs of leaflets, and are used for that purpose where such discrimination is requisite for specific characters, as in the *Mimosæ.*

The following terms are applied to the degree of composition; without any reference to the mode.

1. COMPOUND, (*compositum.*) Pl. 8, fig. 7. Simply compound.

2. DECOMPOUND, (*decompositum.*) Pl. 9, fig. 4. Doubly compound.

3. SUPERDECOMPOUND, (*supradecompositum.*) Pl. 9, fig. 5. Thrice compound or more. Ex. Hemlock, *Conium maculatum.*

Mode and degree of Composition.

1. BIGEMINATE, (*bigeminatum.*) Pl. 9, fig. 3. Twice paired.

2. TERGEMINATE, (*tergeminatum*) three times paired.

3. BITERNATE, (*biternatum*) Pl. 9, fig. 1. Twice ternate.

4. TRITERNATE, (*triternatum.*) Pl. 9, fig. 2. Thrice ternate.

5. BIPINNATE, (*bipinnatum.*) Pl. 9, fig. 4. Doubly pinnate.

6. TRIPINNATE, (*tripinnatum.*) Pl. 9, fig. 5. Triply pinnate.

7. PEDATE, (*pedatum.*) Pl. 9, fig. 6. Is a ternate leaf, with its lateral leaflets compounded in their forepart. Ex. *Viola pedata.*

Observation. 1. Leaves are so wonderfully diversified, and the transition from one form to another is so gradual, that specimens occur, not only to answer the preceding terms, which have been assumed to describe them, but also of every intermediate descrip

tion. On this account two terms are occasionally combined to express a form between them, as Ovate-lanceolate, (*ovato-lanceolatum,*) lanceolate, inclining to ovate; or Heart-ovate, (*cordato-ovatis,*) as in ground Laurel, *Epigæa repens.*

When shape or any other character cannot be precisely defined, *sub* is prefixed to the term used, as *subrotundum,* roundish; *subsessile,* not destitute of a footstalk. By the judicious use of such, means all necessary precision is attained.

2. The leaves furnish very elegant and natural marks in discriminating the species of plants. Numerous specific names, as well as characters, which are both elegant and descriptive, are derived from the leaves, as *Pyrola rotundifolia,* Round leaved Wintergreen; *Convallaria bifolia,* Two-leaved Convallaria; *Aster cordifolius* Heart-leaved Aster.

CHAP. IV.

APPENDAGES TO A PLANT.

THE APPENDAGES consist of the *appendages,* properly so called, the *arms,* the *supports,* and the *pubescence* or covering of plants.

I. *Appendages to the Leaf and to the Flower.*

1. STIPULE, (*stipula.*) Pl. 8, fig. 7 & 8. *a. a.* A leafy appendage to the proper leaves, or to the footstalks. Ex. Rose, *Rosa;* Pea, *Pisum.*

Observation. 1. It is commonly situated at the base of the footstalk in pairs, as it is in the above examples, and is extremely different in different plants.

2 Some stipules fall off almost as soon as the leaves are expanded, which is the case with the Tulip-tree, *Liriodendron tulipifera;* in general they last as long as the leaves.

3. The stipule in the grasses is peculiar, consisting of an internal white membrane, crowning the sheath of the leaf and clasping the culm.

2. BRACT, (*bractea.*) Pl. 9, fig. 7. The floral leaf; a leafy appendage to the flower or its stalk, differing in shape or colour, or both from the other leaves of the plant. Ex. Lime-tree, *Tilea,* in which it serves as a wing to the seed.

II. Arms, (*arma.*)
Weapons of defence.

1. Spine, (*spina.*) Pl. 10, fig, 1. A Thorn. This proceeds, not from the bark, but from the wood itself. Ex. Thorn, *Cratægus.*

Observation. Sometimes disappears by culture.

2. Prickle, (*aculeus.*) Pl. 10, fig. 2. Arises from the bark only, and comes off with it, having no connexion with the wood. Rose and Raspberry.

Observation. Does not disappear by culture.

III. Supports, (*fulcra.*)

1. Tendril, (*cirrus.*) Pl. 8, fig. 8. A fibre, intended to support weak and climbing plants, upon more firm and sturdy ones. Ex. Pea and Cucumber.

Observation. 1. The tendrils of the Creeper, *Vitis quinquefolia,* will adhere to the smoothest flint.

In some cases, the flower and leaf-stalks perform the part of tendrils, by clinging to other bodies for support, as the leaf-stalks do in the Virgin's-bower, *Clematis Virginiana.*

2. Linnæus applied the term supports, (*fulcra*) to all the various kinds of appendages, but it seems not to apply very properly to any of them except the tendril, &c.

3, The prickles of the Sweet-briar Rose, being recurved like hooks, serve as supports by taking hold of other bodies.

IV. Pubescence, (*pubes.*)

Glands, hair, &c. which are found on the surface of the plant.

1. Gland, (*glandula*) a little tumour discharging a fluid. Ex. On the calyx of the Moss Rose. Pl. 10, fig 4, *a.* On the foot-stalks of the Snow-ball, *Viburnum opulus,* and the various species of Passion-flower. Pl. 10, fig. 3.

2. Hair, (*pilus.*) Pl. 10, fig. 6. The hairs on plants are either simple, serving the purpose of protection from cold, or they are ducts, discharging a fluid.

Observation, The hairiness of plants is liable to disappear by culture.

CHAP. V.

INFLORESCENCE,* (*inflorescentia.*)

INFLORESCENCE is a term used by Linnæus, to express the particular manner in which flowers are situated upon a plant.

Observation. Those who wrote before Linnæus used the term *modus florendi*, or manner of flowering.

Its various kinds are

1. WHORL, (*verticellus.*) Pl. 10, fig. 7. Flowers surrounding the stem in a sort of ring; though they may not perhaps be inserted on all sides of it, but merely on two opposite ones. Ex. Mint, *Mentha*, and Balm.

2. RACEME, (*racemus.*) Pl. 10, fig. 8. A cluster. A simple raceme consists of numerous, rather distant, flowers, each on its own proper stalk, and all connected by one common stalk. Ex. A bunch of Currants.

Observation. A cluster is most generally pendulous or drooping, and the flowers all expand nearly at the same time.

Compound receme, (*racemus compositus*) partial peduncles divided. Ex. Solomon's Seal, *Convallaria racemosa*.

Observation. By *partial peduncle*, is meant the *proper peduncle* of the individual flowers, Pl. 10, fig. 8, *a. a.* in opposition to the *common peduncle, b.* which is shared equally by all of them.

Aggregate, (*aggregatus*) several gathered together. Ex. *Actæa racemosa*, Black Snake-root.

Unilateral, (*unilateralis*) one-sided; flowers growing altogether from one side of the common peduncle.

Secundous, (*secundus*) growing out from more than one side, but bending round so as to bring the flowers all to one side.

* The Inflorescence does not strictly belong under the head of *Herbage*, but has a claim to this place, in as much as it depends on the composition and situation of the *Trunks*.

3. SPIKE, (*spica.*) Pl. 10, fig. 9. Bears numerous flowers, ranged along a common stalk, without any partial stalks. Ex. An ear of Wheat; Greater Plantain, *Plantago major.*

Observation. 1. A mode of flowering in which the flowers are ranged alternately upon both sides of a simple flower-stalk.—*Milne.*

2. Some latitude is allowed to this difinition, and the term spike is in many instances applied to flowers, which are not entirely without partial peduncles.—*Smith.*

3. The common stalk of a SPIKE is termed RACHIS, from its resemblance to the back-bone of an animal.

Compound spike, (*spica composita.*) In a compound spike the peduncle is divided.

Spikelet, (*spicula*) is a term applied exclusively to the grasses that have many florets in one calyx, such florets being ranged on a little stalk constituting the spikelet, which little stalk is a part of the flower itself and not of the infloresence.—*Smith.*

Observation.—These little groups of florets in one calyx, are termed spikelets whether they are so disposed as to constitue a spike or a panicle.

Interrupted spike, (*spica interrupta.*) In an interrupted or whorled spike, the flowers are in separate groups. Ex. *Mentha spicata.*

One-rowed, (*secunda*) a spike whose flowers lean all to one side.

Two-rowed, (*disticha*) when the flowers look to both sides or stand two ways.

Spiral, (*spiralis*) twisted like a screw. Ex. Ladies' traces, *Neottia cernua.*

Observation, A spike generally grows erect. Its mode of expansion, is much more progressive than that of the raceme, so that a long period elapses between the fading of the lowest flowers and the opening of the upper ones.

4. CORYMB, (*corymbus.*) Pl. 11, fig. 1. A mode of flowering, in which the lesser or partial flower-

stalks are produced along the common stalk, are of unequal length, the lower ones being longest, and all rise nearly to the same height, so as to form a flat and even surface at top. Ex. *Spiræa opulifolia*, and Yarrow, *Achillea millefolium*.

Observation. A spike, whose partial stalks are gradually longer as they stand lower, so that the flowers are nearly on a level.—*Smith.*

Compound, (*compositus*) when the partial stalks are divided.

5. FASCICLE, (*fasciculus.*) Pl. 11, fig. 2. A little bundle; flowers on little stalks, variously inserted and subdivided, collected into a close bundle, level at top. Ex. Sweet William, *Dianthus barbatus*, and *Dianthus Armeria*.

6. HEAD, (*capitulum*) bears the flowers sessile in a globular form. Ex. Globe Amarathus, *Gomphrena globosa*. High Balm, *Monarda didyma*, and *M. Kalmiana*.

Observation. In the capitulum, the flowers of the summit usually expand first.

7. UMBEL, (*umbella.*) Pl. 11, fig. 3. A mode of flowering in which the several flower-stalks or rays, proceed from one common centre, like the braces of an umbrella.

Observation. The flower-stalks are of such lengths as to elevate the flowers either to a *concave*, a *level*, a *convex*, or even a *globose* surface.

Simple umbel, (*umbella simplex*) when each flower-stalk terminates immediately in a flower. Ex. Silkweed, *Asclepias Syriaca*, and Ginseng, *Panax quinquefolium*.

Compound, (*composita.*) Pl. 11, fig. 3. When each of the flower-stalks, instead of terminating in a flower, bears another umbel, (*umbellula,*) little umbel.

Observation. 1. In a compound umbel, the greater umbel, constituted of the larger set of rays, is termed UNIVERSAL OR GENERAL

umbel ; and the lesser umbels, which are borne by the rays of the greater, are termed PARTIAL umbels.

2. The very extensive natural order of plants called *umbelliferous*, have generally compound umbels. Ex. Carrot, Parsnip, Parsley, Hemlock, &c.

Radiate, (*radiata*) when the outer petals of the external flowers are larger and longer than the rest.

Floscular, (*flosculosa*) when the flowers are all alike in size.

8. CYME, (*cyma.*) Pl. 11, fig. 4. A mode of flowering, which has the general appearance of an umbel, and agrees with it so far, that its common stalks all proceed from one centre, but differs from it in having the partial stalks variously subdivided. Ex. Elder, *Sambucus niger*, and Snowball, *Viburnum.*

9. PANICLE, (*panicula.*) Pl. 11, fig. 5. Bears the flowers dispersed upon foot-stalks variously subdivided.

Observation. It is a sort of branching diffused spike composed of a number of small spikes which are attached along a common footstalk.—*Milne.*

Lax, (*diffusa*) when the stalks are distant. Ex. London pride, *Saxifraga umbrosa*, and Common Oat.

Divaricate, (*divaricata.*) Spreading ; when the partial stalks form an obtuse angle with the common peduncle. Ex. *Briza*, and Red Top, *Agrostis vulgaris.*

Dense, (*coarctata*) when the foot-stalks approach. Ex. *Phleum paniculatum.*

One-sided, (*secunda*) leaning one way. Ex. Orchard grass, *Dactylis glomerata.*

10. THYRSE, (*thyrsus.*) Pl. 11, fig. 6. A panicle contracted into an ovate figure. Ex. Lilac, *Syringa vulgaris.*

Observation. 1. In the thyrsus the inferior peducles extend horizontally, whilst the upper ones are nearly upright.

2. Linnæus remarks that the most elegant specific characters are taken from the inflorescence. Ex. The Apple and Pear, two species of the same genus, *Pyrus*, are distinguished thus : The Apple bears an umbel, the Pear a corymb.

Reference. The insertion of simple flower-stalks, whether *solitary*, *clustered*, *radical*, *cauline*, *axillary*, *lateral* or *terminal*, is defined under PEDUNCLE, page 16.

PART III.

Fructification, (*fructificatio.*)

THE FRUCTIFICATION consists of the Flower and Fruit.

The fructification is a temporary part of vegetables, destined for the reproduction of the species, terminating the old individual and begining the new.

Observation. The fructification is an essential part of every vegetable. Every species of plants produces flower and fruit. The seed is the essence of the fructification, and the whole use of the flower is to serve in perfecting it.

A plant may be propagated by roots, layers, offsets, scions and buds, but the plants thus produced, are only extensions of the same individual, and retain all its peculiarities.*

Although a plant may thus be propagated to a considerable extent, yet it appears that if it be not renewed by seed, it will sooner or later become extinct, or, as it is commonly expressed, will run out; hence we infer that propagation by seed is the only true reproduction of plants.

Linnæus distinguishes seven parts of fructification, some of which are essential to the very nature of a flower or fruit, others not so indispensably necessary, and therefore not always present.

I. Calyx, (*calyx.*) Pl. 13, fig. 1. Flower-cup, generally resembling the leaves in texture and colour, and forming the outermost part of the flower. This is not essential, and is often absent.

Observation. Commonly called the *green leaves* of the flower.

II. Corolla, (*coro'la.*) Pl. 12, fig. 1. *a. a. a.* The more delicate coloured internal leaf or leaves, likewise not essential.

Observation. 1. Commonly called the *flower leaves.*

2. Petal is the term given to each separate leaf of the corolla.

* This is exemplified in the various kinds of apples, which are propagated by engrafting and inoculation.

III. STAMEN, (*stamen.*) Pl. 12, fig. 3. Commonly consisting of a thread-like body, bearing a sack at top, containing a coloured dust, placed internally in respect to the corolla. This is essential.

IV. PISTIL, (*pistillum.*) Pl. 12, fig. 4. In the centre of the flower, consisting of the rudiments of the fruit, with one or more organs attached to them, and, of course, essential.

V. PERICARP, (*pericarpium.*) Pl. 14, fig 6, 7, &c. The seed-vessel, of a pulpy, woody or leathery texture, enclosing the seeds, but wanting in many plants.

VI. SEED, (*semen*) the perfecting of which is the sole end of all the other parts of the fructification.

VII. RECEPTACLE, (*receptaculum.*) Pl. 12, fig. 2, *a.* The basis or point of connexion of the other parts. This must necessarily be present in some form or other.

Observation. Each of these seven parts occurs under a variety of forms, which are next to be explained.

I. *Calyx.*

THE CALYX or external covering of the flower, when present, was originally divided by Linnæus into seven kinds.

Observation. As the student is beginning to examine flowers, he should be reminded that all DOUBLE Flowers, (*flores pleni,*) are imperfect. Although they are esteemed in the gardens as beautiful, yet they are unfit for botanical illustration and have been emphatically called *vegetable monsters.* This fullness or impletion as it is termed, of flowers, takes place in a variety of ways ; but the most common, is by the conversion of the stamens into petals.

The seeds of double flowers are imperfect, because the organs which are necessary to the formation of perfect seed, are obliterated. Impletion is caused by excess of nourishment, and is principally the result of art occuring almost exclusively among cultivated plants. This shews us that deformity, in consequence of luxury, occurs in the natural as well as in the moral world.

The attention of the young botanist is therefore directed to the fields and woods in preference to the garden. The cultivated Rose, Pæony, Double Carnation, &c. are examples of double flowers.

1. PERIANTH, (*perianthium.*) Pl. 13, fig. 1. A calyx which is contiguous to, and makes a part of the

flower. Ex. The five green leaves which encompass a Rose, including their urn-shaped base. The tubular part comprehending the scales at its base in the Pinks.

1. *Number of Leaves.*

1. Monophyllous perianth, (*Perianthium monophyllum*) when it consists of one leaf.

2. Cleft, (*fissum*) divided down not exceeding half way to the base.

3. Parted, (*partitum*) divided almost to the base.

4. Two-leaved, (*diphyllum.*) three-leaved, (*triphyllum,*) and so on, according to the number of leaves.

5. Polyphyllous, (*polyphyllum*) many leaved.

2 *Form.*

1. Inflated, (*ventricosum*) swelled or distended. Ex. *Cucubalus Behen.*

2. Prismatic, (*prismaticum*) with sharp, and somewhat parallel angles. Ex. Monkey Flower, *Mimulus.*

3. Imbricate or scaly, (*imbricatum* or *squamosum,*) Pl. 16, fig. 3. With its leaves lying one over another. Ex. Thistle, and most of the compound flowers.

4. Squarrose, (*squarrosum*) when the leaflets which compose it are bent back at the points.

6. Ciliate, (*ciliatum*) fringed with hairs or bristles on the margin.

7. Muricate, (*muricatum*) set with short stiff prickles.

5. Scariose, (*scariosum*) when the leaflets are hard, thin, and dry.

8. Spinous, (*spinosum*) thorny; each leaflet tipped with a thorn. Ex. Thistles.

9. Turbinate, (*turbinatum*) having the figure of a top.

10. Calyculate, (*calyculatum*) doubled; when one calyx appears to be enclosed at its base by another. Ex. Mallow, *Malva.*

Observation. This part is of an infinite variety of forms, in different genera, being either simple or compound, regular or irregular, equal or unequal. In some instances it is permanent until the fruit is ripe, in others it is caducous, falling even before the flower is well expanded.

2. The Perianth is much the most common kind of calyx. "It is *the calyx* properly and commonly so called," being sometimes denominated *Calyx* by way of eminence, as though there were no others. The genus *Anemone*, for example, is defined to be "without a calyx," while several of the species are acknowledged to have that kind of calyx called *involucrum*.

2. INVOLUCRE, (*involucrum.*) Pl. 11, fig. 3. A calyx remote from the flower. Ex. Hemlock, *Conium maculatum.*

Observation. It usually accompanies an umbel.

1. Universal involucre, (*involucrum universale*) when the leaflets are placed at the origin of the universal umbel. Pl. 11, fig. 3, *a.*

2. Partial, (*partiale*) when the leaflets are placed at the foot of a partial umbel. Pl. 11, fig. 3, *b.*

3. Dimidiate, (*dimidiatum*) placed only on one side. Not going all round.

Observation. The term *involucrum* has been applied to the membranes covering the fructification of ferns. *Inducium* has also been applied to the same.

3. AMENT, (*amentum.*) Pl. 13, fig. 2, 3, & 4. Catkin. A species of calyx, consisting of a number of scales ranged along a common thread-like receptacle, each protecting one or more stamens or pistils. Ex. It is the most common calyx of the forest trees, Oak, Walnut, Chesnut, Birch, Alder, Hazlenut, &c.

Observation. The whole forms an aggregate flower.

4. SPATHE, (*spatha.*) Pl. 13, fig. 5. A calyx which bursts longitudinally, and is more or less remote from the flower. Ex. Common Blue Flag, *Iris*, and *Narcissus.*

Observation. In many cases the spathe is of a membranous texture, and withers soon after the flower is evolved.

Observation. The spathe sometimes encloses a *Spadix* or elongated receptacle common to many flowers. Pl. 13, fig. 5, *a. & b.* Ex. Indian Turnip, *Arum.*

5. GLUME, (*gluma.*) Husk. Pl. 13, fig. 7. The calyx of the grasses, and grass-like plants of a chaffy texture.

Each separate piece of the glume is termed a valve.

Observation. 1. To the glume belongs the AWN, (*arista*) beard; a bristle-shaped appendage, usually spiral or twisted, and possessing the property of being moved by moisture. This is what gives motion to what is called the animated oat.

2 The corolla of grasses is precisely of the same husky nature of their calyx, and is by some botanists considered as such.

6. CALYPTRA, (*calyptra.*) Pl. 13, fig. 8. The calyx of the mosses, which is placed over the unripe fruit like an extinguisher upon a candle, but is soon torn from its base and elevated along with the ripening capsule.

Observation. Sir J. E. Smith considers it a species of corolla. The same author makes another species of calyx, *Perichætium*, a scaly sheath investing the fertile flower, and consequently the base of the fruit-stalk in some mosses.

7. VOLVA, (*volva.*) Pl. 2, fig. 9. *b.* Wrapper or covering of the *Fungus* tribe. It first envelops the head of the *Fungus*, afterwards bursts and appears in a lacerated form about the trunk.

II. *Corolla.*

THE COROLLA. Pl. 12, fig. 1, *a. a. a.* Commonly called the flower-leaves, consists of those more delicate and dilated, generally more coloured leaves, which are always internal with respect to the calyx, and constitute the chief beauty of the flower. Ex. In the Rose the corolla is red and fragrant; in the Violet, purple; in the Primrose, yellow.

The term corolla includes two parts, the PETAL, (*petalum*) and the NECTARY, (*nectarium.*) The Nectary is to be treated of in a separate section.

The following terms are applied to the corolla.

1. *Number of Petals.*

1. MONOPETALOUS COROLLA, (*corolla monopetala.*) Pl. 13, fig. 10. Consisting of only one petal or leaf. Ex. Thorn-Apple, *Datura stramonium.*

Tube, (*tubus.*) Pl. 13. fig. 10, *a.* The narrow, hollow part of a monopetalous corolla, by which it is fixed to the receptacle.

Limb, (*limbus.*) Pl. 13, fig. 10. *b.* The border, or upper dilated part.

Orifice, (*faux*) jaws or throat; the opening of the tube.

Observation. DIPETALOUS, TRIPETALOUS, TETRAPETALOUS, PENTAPETALOUS, and HEXAPETALOUS, are terms applied according to the number of petals.

2. POLYPETALOUS, (*polypetala*) consisting of many petals. Ex. Water Lily, *Nymphœa.*

Observation. Linnæus uses this term in opposition to the monopetalous corolla. By other writers it is usually put down for a flower consisting of more than six petals.—*Martyn.*

Claw, (*unguis.*) Pl. 13, fig. 15, *a.* Is the narrow part of the petal of a polypetalous corolla, by which it is attached to the receptacle.

Border, (*lamina.*) Pl. 13, fig. 15, *b.* The upper spreading part.

Observation. This corresponds to the Limb of a monopetalous corolla, and the Claw, to the Tube.

2. *Proportion of the Petals.*

1. REGULAR, (*regularis*) when it consists of petals equal in size and similar in form. Ex. Rose.

2. IRREGULAR, (*irregularis*) when it consists of irregular and dissimilar petals, which are generally accompanied with a nectary. Ex. Larkspur and Violet.

3. EQUAL, (*æqualis*) see regular.

4. UNEQUAL, (*inæqualis*) when some segments are smaller than others. Ex. *Veronica.*

3. *Form.*

1. BELL-SHAPED, (*campanulata.*) Pl. 13, fig. 9. Without a tube, expanding immediately from the receptacle. Ex. Bell-flower, *Campanula.*

2. FUNNEL-SHAPED, (*infundibuliformis.*) Pl. 13, fig. 10. Tubular at bottom, but gradually expanding towards the top. Ex. Thorn-Apple, *Datura.*

3. SALVER-SHAPED, (*hypocrateriformis.*) Pl. 13, fig. 11. Having the border spread out horizontally and placed on a tube. Ex. *Phlox.*

Observation. Resembling an old-fashioned salver.

4. WHEEL-SHAPED, (*rotata.*) Pl. 13, fig. 12. A flat border with scarce a tube. Ex. Potatoe, *Solanum tuberosum*, and Borage, *Borago.*

5. RINGENT, (*ringens.*) Pl. 13, fig. 13. Irregular and gaping like the mouth of an animal. Ex. Hyssop, *Hyssopus.*

Observation. A ringent flower is an irregular one-petaled corolla, the border of which is divided into two parts, called the upper and the lower lips.

The following terms are sometimes applied to the parts of a ringent corolla.

1. Helmet, (*galea.*) Pl. 13, fig. 13, *a.* The upper lip.

2. Beard, (*barba.*) Pl. 13, fig. 13, *b.* The lower lip.

3. Gape, (*rictus*) the space between the lips.

4. Throat or Jaws, (*faux*) the opening of the tube.

5. Palate, (*palatum*) the prominent swelling in the throat.

6. Neck, (*collum*) the upper part of the tube.

6. PERSONATE, (*personata.*) Pl. 13, fig. 14. Resembling the ringent, but having the throat closed with a permanent swelling called the palate, (*palatum.*) Ex. Toad-flax, *Antirrhinum.*

7. TUBULAR, (*tubulata.*) Pl. 16, fig. 1, *a.* Is ap-

plied to the floret of a compound flower, when it ends in a tube, the border being five cleft.

8. LIGULATE, (*ligulata.*) Strap-shaped. Pl. 16, fig. 1, *b.* Also a floret of a compound flower tubular at base, but terminating in a flat strip extending out at one side.

9. CRUCIFORM, (*cruciformis.*) Cross-shaped. Pl. 13, fig. 15. composed of four equal petals placed in the form of a cross. Ex. Cabbage, Mustard, Radish, and Shepherd's purse.

10. ROSACEOUS, (*rosacea*) consisting of five petals resembling a rose. Ex. Strawberry.

11. LILIACEOUS, (*liliacea.*) Pl. 12, fig. 1. Resembling a lily, consisting of six fleshy petals. Ex. Dog-tooth Violet, *Erythronium* and Tulip.

12. PAPILIONACEOUS, (*papilionacea.*) Butterfly-shaped. Pl. 14, fig. 1 & 2. Irregular and spreading, somewhat like a butterfly. Ex. Pea.

The various petals which compose such a flower are distinguished by appropriate names, as

1. Banner, (*vexilum.*) Pl. 14, fig. 2, *a.* The large one at the back.

2. Wings, (*alæ*) *b. b.* the two side petals.

3. Keel, (*carina*) *c.* consisting of one or two petals embracing the internal organs, and resembling a boat in form.

13. INCOMPLETE, (*incompleta*) when parts, which analogy would lead us to expect, are deficient. Ex. *Amorpha*, a papilionaceous flower, apparently but consisting of the banner only.

Observation. It is remarkable that irregular flowers sometimes vary to regular ones in the very same plant, as in *Bignonia radicans.*

4. *Duration.*

1. CADUCOUS, (*caduca*) falling before the stamens.

2. DECIDUOUS, (*decidua*) falling with the stamens.

3. MARCESCENT, (*marcescens*) withering, without dropping.

Observation. 1. The corolla may usually be distinguished from the calyx by the fineness of its texture and brilliancy of colour.

The calyx is generally of a rough and thick texture and usually green. But there are many exceptions; the calyx is in some cases coloured,* and the corolla in some green. Linnæus distinguishes them thus; the calyx has its leaves or segments opposite the stamens, while the petals or segments of the corolla alternate with them.

2. The corolla is wanting in many plants, and therefore, the office it performs, whatever it may be, is either dispensed with, being not essential, or is performed by some other part.

The uses of this very conspicuous part have not yet been fully explained; the following have been assigned to it.

1. To protect the tender and important parts within, especially from wet.

2. To furnish a resting place for insects in search of honey.

3 To submit the juices to the action of air and light. Dr. Darwin calls the corolla, the lungs of the stamens and pistils, and with great probability, for it abounds with air vessels.

St. Pierre supposes the corolla to regulate the sun's influence on the fructification of the plant, by reverberating the solar rays upon the anthers and stigma; or, in some instances, by sheltering them from too intense heat.

Nectary, (*nectarium*) is the part of the corolla which contains, or which secretes honey.

Observation. 1. Linnæus usually called every supernumerary part of the flower Nectary, from analogy only, though he might not, in every case, be able to prove that such parts produced honey.

2. The nectary is confined to no particular part of the flower, but is extremely various in situation as well as form. It cannot, in all cases, be considered as a part of the corolla.

In relation to the corolla, nectaries are of four kinds.

1. A mere cavity in the corolla, as the groove in the claw of the petal of the Lily, and the cavity near the base of the petal in Crown Imperial.

2. A process of the corolla itself, as the scale of the *Ranunculus* and the spur of the Violet.

3. An organ separate entirely from the petals, but of a similar texture and colour, as in Columbine, *Aquilegia.* Pl. 14. fig. 3.

4. An organ separate from the corolla and dissimilar in structure, as in Jack-in-a-bush, *Nigella*, and Monk's-hood, *Aconitum.* Fig. 5.

The following are some of the forms of the nectary.

1. Spur or horn-shaped, (*nectarium corniculatum.*)

* Coloured is here technically used for any other colour than green.

Pl. 14, fig. 3. Ex. Larkspur, *Delphinium* and Nasturtium, *Trapæolum*.

2. Cup-shaped. Pl. 13, fig. 6. Ex. *Narcissus*.

3. Scale, (*squama*.) Ex. Buttercup, *Ranunculus*.

4. Glandular, (*glandulosum*.) These actually secrete honey, and are the most indubitable of all nectaries. In the cruciform plants, as Cabbage, Turnip, Mustard, Radish, Gilly-flower, &c. they are four green glands at the base of the stamens.

Observation. In monopetalous corollas, the tube contains, and probably secretes the honey.

General observation. 1. There can be no doubt that the sole use of the honey with respect to the plant is to tempt insects, who, in procuring it, fertilize the flower by disturbing the dust of the stamens, and even carry that substance from the barren to the fertile blossoms.—*Smith.*

2. In discriminating the genera, the nectary often furnishes the essential character.

III. *Stamens.*

STAMENS, (*stamina*.) Pl. 12, fig. 1, *b. b. b.* These are situated internally as it respects the calyx and corolla, and externally with respect to the pistils. They are various in number in different flowers, from one to some hundreds.

The Stamen commonly consists of two parts.

1. FILAMENT, (*filamentum*.) Pl. 12, fig. 3, *b.*; and

2. ANTHER, (*anthera*) *a*, which is elevated upon the filament.

The filament is sometimes wanting, when the anther is termed Sessile, (*sessilis*.)

The ANTHER is generally of a membranous texture, consisting of two cells or cavities bursting longitudinally at their outer edges, as in the Lily. In the Potatoe, in the *Kalmia*, and some others, it opens by pores at the summit.

The POLLEN is a powder or dust, which is contained by the anther and discharged chiefly in warm dry weather, when the coat of the anther contracts and

bursts. Each grain of the pollen is commonly a membranous bag, round or angular, rough or smooth, which remains entire till it meets with moisture, being contrary in this respect to the nature of the anther; then it burst with great force, discharging a most subtle vapour.

Observation. The stamens are changed to petals in double flowers, and rendered useless, as in Piony. They are often obliterated by excessive nourishment, as in the Snow-ball or Guelder Rose, *Viburnum Opulus.*

IV. *Pistils.*

PISTILS, (*pistilla.*) These are situated within the stamens in the centre of the flower. Like the stamens they vary in number in different flowers from one, to hundreds.

Each pistil, Pl. 12, fig. 4, consists of three parts.

1. GERMEN, (*germen*) *c*, the rudiment of the fruit and seed.

Observation. The Germen is termed

SUPERIOUR, (*superum*) when it is above the calyx and corolla, as in the Strawberry and Raspberry.

INFERIOUR, (*inferum*) when it is below them, as in the Apple and Pear. The situation of the calyx and corolla is the opposite of that of the germen, being INFERIOUR when the germen is SUPERIOUR, and SUPERIOUR when it is INFERIOUR.

2. STYLE, (*stylus*) *b.* This is often wanting, and serves merely to elevate the third part, the stigma.

3. STIGMA, (*stigma*) *a*, the top of the pistil which receives the pollen from the anthers.

This is always present. Its shape is various, either simple, scarcely more than a point; or capitate, forming a little round head; or variously lobed. Sometimes hollow and gaping, more especially when the flower is in its highest perfection, very generally downy, and always more or less moist, with a peculiar viscid fluid, which in some plants is so copious as to form a large drop, though never big enough to fall to the ground.

Functions of the Stamens and Pistils.

These parts contribute to the perfecting of the seed in the following manner.

After the flower is expanded the anther bursts in dry weather and discharges the pollen, the particles of which, come in contact with the stigma, and meeting with the viscid moisture with which this part is covered, explode and discharge their contents, which are said to be a subtle vapour.

It is probable that the contents of the pollen are absorbed by the stigma and transmitted to the rudiments of the seeds in the germen.

This contact of the pollen with the stigma seems to be the great object of the flower, by which it renders the seed perfect and capable of vegetating; and no seed is perfect or will grow, unless it has taken place.

The stamens and pistils, or more particularly, the *anther*, *stigma* and *germen*, are indispensable to the performance of this important function.* All other parts may be, and occasionally are, wanting.

Observation. The corolla first attracted the attention of botanists, and is considered by the vulgar the most important part, but the stamens and pistils are essentially *the flower*, and constitute one in effect without any other part. They are presumed to be essential to all plants.

Linnæus clearly established these doctrines, and fortunately fixed upon the stamens and pistils, organs necessarily universally present, as the foundation of his first divisions of the vegetable kingdom, the classes and orders.

Situation of the Stamens and Pistils.

The stamens and pistils are situated together in the same flower, as in the Lily and most plants; or in separate flowers on the same plant, as Indian Corn, *Zea*

* Mare's tail, *Hippuris*, an exotic plant, has a flower of the most simple structure, having only one stamen and one pistil, without any calyx or corolla.

Mays; Cucumber, *Cucumis*; or in separate flowers on separate plants, as in the Willow.

This gives rise to the following distinctions of flowers.

1. BARREN FLOWERS, flowers having stamens only.

Observation. 1. Called BARREN because they produce no seed.
2. Sometimes called STAMEN-BEARING or STAMENIFEROUS.

2. FERTILE, having pistils only.

Observation. 1. Called FERTILE because they bear seed.
2. Sometimes called PISTIL-BEARING or PISTILIFEROUS.

3. PERFECT, furnished with both stamens and pistils.

Observation. 1. Called PERFECT because they contain both the rudiments of the seeds, and all that is necessary to perfect them.
2. On account of the separation of the stamens and pistils in the barren and fertile flowers, they have been termed SEPARATED FLOWERS; and on account of their union in perfect ones, they have been denominated UNITED FLOWERS.

V. *Pericarp.*

PERICARP, (*pericarpium*) the seed vessel; which is formed by the germen enlarged.

Observation. It is not an essential part, the seeds being frequently naked and guarded only by the calyx, as in Motherwort, *Leonurus*. The use of the seed vessel is to protect the seeds till ripe, and then in some way or other to promote their dispersion, either by scattering them by its elastic power, or by serving as food for animals.

Pericarps are of several kinds.

1. CAPSULE, (*capsula.*) Pl. 14, fig. 6. A dry seed-vessel of a woody or membranous texture. Ex. Thorn-apple, *Datura stramonium.*

Terms applied to the parts of seed-vessels and principally to the parts of a capsule.

1. Valves, (*valvulæ*) the pieces into which a capsule usually splits.

Observation. Although the capsule usually splits into valves, yet it sometimes discharges its contents by orifices or pores, as in Bell-flower, *Campanula*, and Poppy, or falls off entire with the seed.

2. Sutures, (*suturæ*) the seams by which the valves are united to each other.

3. Cells, (*loculi.*) Pl. 14, fig. 6, *a.* The cavities containing the seeds.

4. Dissepiments, (*dissepimenta*) partitions between the cells.

5. Collumn, (*collumella*) *b.* The pillar to which the seeds are attached.

Observation. The capsule is called *one-valved, two-valved*, &c. according to the number of valves; and *one-celled, two-celled*, &c according to the number of cells.

2. Silique, (*siliqua*) Pod. Pl. 14, fig. 7. A long, dry, solitary seed-vessel, consisting of two valves with a dissepiment intervening, seeds attached alternately to one and the other suture. Ex. Cabbage, Radish, &c.

Silicle, (*silicula.*) Pl. 14, fig. 8. A silique or pod, of a short rounded figure. Ex. Shepherd's purse, *Thlaspi.*

Observation. Nearly or quite as broad as long.

3. Legume, (*legumen.*) Pl. 14, fig. 9. A membranous seed-vessel of two valves, no dissepiment, seeds attached to one suture only. Ex. Pea and Bean.

Observation. Sometimes this kind of fruit lodges but one seed, as in Clover.

Loment, (*lomentum*) expresses an elongated seed-vessel, consisting of two valves, externally forming sutures, but never bursting like the legume. Internally it is divided into cells by small transverse partitions. Ex. *Cassia* and *Hedysarum.*

4. Drupe, (*drupa*) Stone-fruit. Pl. 14, fig. 10. Consists of a pulpy coat enclosing a nut. Ex. Peach, Plumb, Cherry, &c.

5. POME, (*pomum.*) Pl. 14, fig. 11. Has a pulpy coat like the drupe, but contains a capsule with several seeds. Ex. Apple and Pear, *Pyrus.*

6. BERRY, (*bacca.*) Pl. 14, fig. 12. A fleshy pericarp without valves, containing one or more seeds enveloped with pulp. Ex. Gooseberry and Currant, *Ribes.*

Compound Berry, (*bacca composita.*) Pl. 14, fig. 13. Consists of several single ones, each containing a seed, united together. Ex. Raspberry, *Rubus.* Each separate grain is denominated *Acinus.*

Observation. The melon and cucumber tribe have a berry of a peculiar kind; the cells together with the seeds are remote from the centre, the seeds being inserted into the sides of the fruit.

7. STROBILE, (*strobilus*) Cone. Pl. 14, fig. 14. Is a catkin or ament, hardened and enlarged into a seed-vessel. Ex. Pine and Fir.

VI. *Seeds.*

SEEDS, (*semina*) are the "sole end and aim of all the organs of the fructification. Every other part is, in some manner, subservient to the forming, perfecting, or dispersing of them."

A Seed consists of several parts.

1. CORCULE, (*corculum.*) Pl. 16, fig. 8, *b. c.* This is the chick or embryo of the future plant. It is the essential part of the seed, to which all the rest are wholly subservient, and without which no seed will vegetate.

The Corcule consists of two parts.

1. Radicle, (*radicula*) *b*, the descending part, which unfolds itself into roots.

2. Plume, (*plumula*) *c*, the ascending part, which unfolds itself into herbage.

2. COTYLEDONS, (*cotyledones.*) Seed-lobes. Pl. 16, fig. 8, *a. a.* They usually constitute the principal bulk of the seed. They are attached immediately to the

corcule, which they nourish until it has taken sufficient root to support itself from the earth.

Observation. The cotyledons are commonly two in number, as in the Bean. They rise out of the ground with the plume, and become the Seminal leaves, (*folia seminalia*) Pl. 16, fig. 10, still supplying nourishment to the young plant, and acting as lungs to it by permitting the juices to be changed in them by the action of light and air.

From their Cotyledons Plants are denominated

1. Acotyledonous, (*acotyledones*) supposed to have no cotyledons. Ex. Ferns.

2. Monocotyledonous, (*monocotyledones.*)Pl. 16, fig. 7. Having one cotyledon or lobe. Ex. Grasses.

3. Dicotyledonous, (*dicotyledones.*) Pl. 16, fig. 8. Having two. Ex. Bean, Pea.

4. Polycotyledonous, (*polycotyledones.*) Pl. 16, fig. 9. Having several. Ex. Pine and Fir.

3. Skin, (*testa*) envelopes the other parts, giving them their proper shape; for the skin is properly formed while they are a homogenous fluid.

Observation. 1. This is sometimes lined with a fine and delicate membrane.

2. There is in some cases a loose coat (*arillus*) external to the skin, which generally falls off when the seed is ripe.

4. Scar, (*hilum*) is the point by which the seed is attached to the vessel or receptacle.

Observation. At this point all the parts of the seed are connected; through this part it is nourished while connected with its parent plant; and through it also, it imbibes the juices of the earth previous to germination.

Appendages to the seed.

1. Pappus, (*pappus.*) Pl. 16, fig. 5, *c.* The feathery crown of seeds calculated to waft them in the wind. Ex. Dandelion, Thistle.

2. Stipe, (*stipes*) *b.* A thread which connects the pappus with the seed.

The Pappus is termed

1. Stipitate, (*stipitatus*) when supported on a stipe. Ex. Dandelion.

2. Sessile, (*sessilis*) when it is immediately connected with the seed. Ex. *Apargia.*

3. Pilose, (*pilosus*) when it consists of simple hairs. Ex. Golden Rod, *Solidago.*

4. Plumose, (*plumosus*) when each hair is branched like a feather. Ex. Dandelion.

5 Membranaceous, when it consists of thin, transparent leaves.

3. TAIL, (*cauda*) is an elongated, generally feathery, appendage to some seeds formed from the permanent style. Ex. Virgin's bower, *Clematis*; Avens, *Geum.*

4. WING, (*ala*) a dilated membranous appendage to seeds. Ex. Catalpa tree and Trumpet-flower, *Bignonia.*

DISSEMINATION, (*disseminatio*)

The various contrivances of nature to disperse and scatter abroad the seeds.

Observation The various modes by which seeds are dispersed, is a subject truly wonderful, and cannot fail to excite admiration in an observing mind. The numerous organs evidently constructed for this peculiar purpose are alone sufficient to prove, beyond a possibility of doubt, that the creation is the product of superiour intelligence and design.

Naturalists observe four means of dissemination.

1 Rivers and running waters. 2. Wind. 3. Animals. 4. An elastic capsule.

1. Seeds are often conveyed by running waters a great distance from their native soil, and cast upon a very different climate, to which, however, by degrees, they render themselves familiar.—*Milne*

2. Those which are carried by the wind, are either furnished with a pappus, as in the Dandelion, Thistle, and other compound flowers, or with a wing, as the Maple, Ash, Trumpet-flower, &c. The bractea of the Lime-tree or Basswood, *Tilea*, serves to wing the seed; it is placed obliquely, so as to give a rotatory or whorling motion as it falls. Winged seeds generally are so constructed as to acquire a rotatory motion as they fall, and are thus suspended some time in the air.

Many seeds, in addition to the means of dissemination, are calculated to bury themselves in the earth. The seeds of many of the compound flowers, as the Dandelion, have barbs pointing up-

ward in such a way, that after they are thrown down, the wind, by moving the pappus, works them into the earth. The Animated Oat, being moved by every change of moisture, affecting its twisted awn, works its way into the earth with wonderful certainty.

3. Animals feed on the pulpy fruits, and at the same time disperse their seeds, voiding them in a condition to vegetate.

Some seeds attach themselves to animals, by means of barbs and hooks, which are either affixed to the seeds themselves, as in Carrot, or to their calyx, as in Burdock, Agrimony and *Bidens*.

4. The Touch-me-not, *Impatiens*, is a common example of an elastic capsule.

VII. *Receptacle.*

RECEPTACLE, (*receptaculum.*) Pl. 12, fig. 2, *a.* Is the common base or point where all the other parts of the fructification unite.

It is termed

1. PROPER, when it belongs to a *simple flower.*

2. COMMON, when it belongs to *aggregate flowers,* which see below.

Observation. It is not a very definite part in simple flowers, there being no particular line of separation between it and the other parts; in the compound flowers, as the Dandelion, Sunflower, &c. it constitutes a remarkable and important part.

Simple and Aggregate Flowers.

1. A SIMPLE FLOWER, (*flos simplex*) is a flower which has a single fructification, complete in all its parts, none of which are common to many flowers, as the Rose and Lily.

Observation. A flower furnished with both calyx and corolla, is termed a COMPLETE flower, (*flos completus;*) when the latter is wanting, INCOMPLETE, (*incompletus;*) and when the corolla is present without a calyx, NAKED, (*nudus.*)

2. AGGREGATE FLOWER, (*flos aggregatus*) is applied by Linnæus to such flowers as are made up of a number of smaller flowers, collected together by means of a part, either a *calyx* or *receptacle,* common to them all.

Observation. Each of the flowers, which goes to constitute an aggregate flower, is called a FLORET, (*flosculus*) little flower; and, from the above description, it is evident, does not constitute a complete flower of itself, as one or two of the essential parts of a flower are common to the whole aggregate. It happens, however, sometimes, that the floret will be furnished with a part analogous

to the common part in the aggregate; thus, besides a common calyx, each floret may have its own proper calyx.

Linnæus enumerates seven kinds of aggregate flowers.

1. AGGREGATE FLOWER, (*flos aggregatus*) properly so called, which has a common undivided receptacle, the anthers all separate and distinct.

Observation. Flowers usually blue, purple or white.

2. COMPOUND FLOWER (*flos compositus*) has also a common undivided receptacle, but the filaments, which are five, have their anthers united into a tube. Ex. Dandelion, Sunflower, Daisy, &c.

Observation. These constitute the class Syngenesia, which see. Flowers usually yellow, especially in the centre or disk.

3. AMENTACEOUS (*flos amentaceus*) has a thread-like receptacle, along which are disposed scales, each of which is accompanied with one or more stamens or pistils. Ex. Willow and Alder. See AMENT, page 48.

Observation. 1. The greatest part of the amentaceous flowers are separated.

2. The birch, *betula;* beech, *fagus;* poplar, *populus;* hazel, *corylus;* hornbean, *carpinus;* pine, *pinus;* walnut, *juglans;* oak, *quercus;* and some other trees, are amentaceous. The fertile flowers of some of these are not aments, as the walnut, oak, and hazel.

4. GLUMOSE, (*flos glumosus*) has a slender, thread-shaped receptacle, along which are disposed a number of florets, all enclosed in a common calyx, termed GLUME, (*gluma.*) Ex. Grasses.

5. SPADICEOUS, (*flos spadiceus*) a sheathed flower, in which the receptacle common to many florets is a *spadix*, enclosed with a sheath (*spatha.*) Ex. Common Dragon Wild Turnip, *Arum.*

6. UMBELLATE, (*flos umbellatus*) in which the florets are borne on footstalks produced from a common receptacle. Ex. Hemlock, Carrot. See UMBEL, p. 42.

7. CYMOSE, (*flos cymosus*) consists also of florets borne on foot-stalks produced from a common receptacle. Ex. Elder, *Sambucus.* See CYME, p. 43.

PART IV.

SYSTEM OF LINNÆUS, &c.

According to the Linnæan system, the vegetable kingdom is divided into Classes, Orders, Genera, and Species. See page 4.

Observation. 1 These divisions and subdivisions of the vegetable kingdom enable a student to find out the name and history of an unknown plant, in the most expeditious manner, by referring it, in the first place, to its class, and to its order in that class; then determining to what genus it belongs, and what species it is in the genus, which is the individual: whereas, without method and system, he would have been under the necessity of searching over the descriptions of all the plants known.

2. The Classes and Orders are called *artificial divisions*, in opposition to *natural* ones, because they are professedly constructed to serve the purpose of mere convenient divisions, stamped by a definite mark by which the individuals of each may be at once recognised; and because they, in many instances, bring together, in the same division, plants which are dissimilar, agreeing only in the assumed technical character of such division, as the Elm and Carrot, which, notwithstanding they are very unlike, belong to the same class and order merely, because they have each the same number of stamens and pistils; whereas *natural divisions* bring together such only as are similar, allied by numerous affinities, as the Carrot and Parsnip. The Genera are founded on natural affinities, and are natural of course. The genera are naturally divided into species. See observations on Natural Orders.

It is no objection to artificial divisions, that they bring together, in the same division, objects which are dissimilar; but their characters should be so constructed, that they should not separate those which are very closely allied, as the various species of the same genus.

CHAP. I.

CLASSES AND ORDERS.

I. Classes, (*classes.*)

THE CLASSES of Linnæus are twenty-four, and their distinctions are founded on the number, situation or proportion of the stamens. Their names are of Greek derivation, and are expressive of their characters. The first eleven are characterized solely

By the number of the Stamens.

Plate 15 contains figures of the 24 classes.

1. Monandria, 1 stamem. Ex. Glasswort, *Salicornia.*

Observation. A small class.

2. Diandria, 2 stamens. Ex. Lilac, *Syringa.*

3. Triandria, 3 stamens. Ex. Blue Flag, *Iris.* Most of the grasses belong to this class.

4. Tetrandria, 4 stamens. Ex. Plantain, *Plantago.*

5. Pentandria, 5 stamens. Ex. Thorn-apple, *Datura.*

Observationon. A numerous class.

6. Hexandria, 6 stamens. Ex. Lily, *Lilium.*

7. Heptandria, 7 stamens. Ex. *Trientalis.*

Observation. A very small class.

8. Octandria, 8 stamens. Ex. Primrose, *Œnothera.*

9. Enneandria, 9 stamens. Ex. Sassafras, *Laurus.*

Observation. A small class.

10. Decandria, 10 stamens. Ex. Pink, *Dianthus.*

11. Dodecandria, 12 to 19. Ex. Canada Snakeroot, *Asarum.*

By Number and Insertion.

12. Icosandria, 20 or more stamens *inserted into the calyx.* Ex. Apple, Pear, Cherry, Plum, Raspberry,

Strawberry, and other fruits. The Rose is an example; also, the Five-finger and Avens, which have not pulpy fruits.

Observation. 1. A natural class.*

2. The stamens are often inserted so near the receptacle as to resemble the next class, but the student will generally distinguish it by a polished groove, which runs around between the insertion of the stamens and the insertion of the pistils.

13. POLYANDRIA, stamens more than 20, *inserted into the receptacle.* Ex. Poppy, *Papaver*; Buttercup, *Ranunculus.*

Observation. A numerous class, very distinct in nature, as well as character, from those of *Icosandria.*

By Proportion.

14. DIDYNAMIA, stamens 2 long and 2 short. Ex. Motherwort, *Leonurus*; Mint, *Mentha.*

Observation. This is a natural class, and contains most of the ringent and personate flowers. Some plants with ringent flowers want two of the stamens, and therefore are placed in the 2d class, *Diandria.* Penny-royal, *Cunilla*; Sage, *Salvia*; and Water-horehound, *Lycopus*, are examples.

15. TETRADYNAMIA, stamens 4 long and 2 short. Ex. Stock, Radish, Mustard, Cabbage.

Observation. A very natural class, comprehending all the cruciform flowers.

By Union of the Filaments.

16. MONADELPHIA, stamens united more or less extensively into one tube. Ex. Mallow, *Malva.*

17. DIADELPHIA, stamens united into two parcels. Ex. Pea, Bean.

Observation. This class consists of Popilionaceous flowers, and is therefore natural.

18. POLYADELPHIA, stamens united into more than two parcels. Ex. St. John's wort.

Observation. A small class; in some points related to *Icosandria.*

* A class or order is said to be natural, when all the genera which compose it have a degree of resemblance to each other, or, in other words, are allied by affinities.

By Union of the Anthers.

19. SYNGENESIA, stamens united by their anthers into a tube, flowers compound. Ex. Dandelion, Sunflower, Thistle, &c.

Observation. A very natural and extremely numerous class.

By Union of the Stamens and Pistils.

20. GYNANDRIA, stamens united with or growing out of the pistil. Ex. *Orchis* and Ladies' slipper, *Cypripedium.*

By the Situation of the perfect, barren, and fertile Flowers.

21. MONOECIA, stamens and pistils in separate flowers on the same plant. Ex. Indian Corn, *Zea;* Hazel, *Corylus;* Alder, *Alnus.*

Observation. In India Corn, the spike or spindle, so called, at top bears the stamens, and the ear the pistils, the styles of which are what are called the silk.

22. DIOECIA, stamens and pistils in separate flowers on two separate plants of the same species. Ex. Willow and Hop.

Observation. These two last classes are natural when the barren flowers have, besides the difference in their essential organs, a different structure from the fertile ones in other respects; but not so when they have the same structure, because then both organs are liable to meet in the same flower.—*Smith.*

23. POLYGAMIA, stamens and pistils separate in some flowers, united in others, either on the same plant, or on two or three separate ones of the same species. Ex. Maple, *Acer.*

Observation. As many plants do, occasionally, have their stamens and pistils separate in some flowers, Smith proposes to confine this class to those in which the three kinds of flowers differ in their general structure.

By Concealment.

24. CRYPTOGAMIA, stamens and pistils obscure. Ex. Ferns, Lichens, Seaweeds, and Mushrooms.

Observation. Either not well ascertained or not to be numbered with any certainty, insomuch that the plants cannot be referred to any of the foregoing classes.

Derivation of the names of the Classes.

1. Monandria, from μονος *monos*, one, & ἀνηρ *aner*, which is used to signify a stamen.
2. Diandria, δις *dis*, two, & ἀνηρ *aner*.
3. Triandria, τρεις *treis*, three, & ἀνηρ *aner*.
4. Tetrandria, τετταρες *tettares*, four, & ἀνηρ *aner*.
5. Pentandria, πεντε *pente*, five, & ἀνηρ *aner*.
6. Hexandria, ἑξ *ex*, six, & ἀνηρ *aner*.
7. Heptandria, ἑπτα *epta*, seven, & ἀνηρ *aner*.
8. Octandria, ὀκτω *octo*, eight, & ἀνηρ *aner*.
9. Enneandria, ἐννέα *ennea*, nine, & ἀνηρ *aner*.
10. Decandria, δεκα *deka*, ten, & ἀνηρ *aner*.
11. Dodecandria, δωδεκα *dodeka*, twelve, & ἀνηρ *aner*.
12. Icosandria, εἰκοσι *eikosi*, twenty, & ἀνηρ *aner*.
13. Polyandria, πολυς *polus*, many, & ἀνηρ *aner*.
14. Didynamia, δις *dis*, two, & δύναμις *dunamis*, power.
15. Tetradynamia, τέτταρες *tettares*, four, & δύναμις *dunamis*.
16. Monadelphia, μονος *monos*, one, & ἀδελφος *adelphos*, brotherhood.
17. Diadelphia, δις *dis*, two, & ἀδελφος *adelphos*.
18. Polyadelphia, πολυς *polus*, many, & ἀδελφος *adelphos*.
19. Syngenesia, συν *sun*, together, & γένεσις *genesis*, producing.
20. Gynandria γυνε *gune*, a pistil, & ἀνηρ *aner*, a stamen.
21. Monoecia. μονος *monos*, one, & οἰκος *oikos*, a house.
22. Dioecia, δις *dis*, two, & οἰκος *oikos*.
23. Polygamia, πολυς *polus*, many, & γαμος *gamos*, marriage.
24. Cryptogamia, κρυπτω *kruptos*, concealed, & γαμος *gamos*.

II. Orders.

THE ORDERS are divisions of the classes. In the thirteen first classes, they are founded on the number of styles or on that of the stigmas, when the styles are wanting.

Observation. Their names are of Greek origin and are indicative of their characters. They are mostly from the Greek numerals *Monos, Dis, Treis,* &c. and *Gune,* which is used to signify a pistil.

MONOGYNIA, 1 style or sessile stigma.
DIGYNIA, 2 styles or sessile stigmas
TRIGYNIA, 3 — ——
TETRAGYNIA, 4 — ——
PENTAGYNIA, 5 — ——
HEXAGYNIA, 6 — ——

Observation, Of rare occurrence.

HEPTAGYNIA, 7 — ——

Observation. Still more rare.

OCTAGYNIA, 8 — ——

Observation. Scarcely occurs at all.

ENNEAGYNIA, 9 — ——

Observation. Hardly an instance known.

DECAGYNIA, 10 — ——
DODECAGYNIA, about 12 ——
POLYGYNIA, many ——

Observation. 1. The grasses which constitute a natural order, belong principally to the third Class, TRIANDRIA, and to the second Order, *Digynia.*

2. To the fifth Class, PENTANDRIA, and to the second Order, *Digynia,* belong the great natural family of umbelliferous plants, of which the Parsnip and Carrot are examples.

CLASS 14, *Didynamia.*

In this class there is but a single pistil. The orders, both natural, are characterised by the fruit.

1. GYMNOSPERMIA, (γυμνος *gumnos,* naked, and σπερμα *sperma,* seed) seeds naked in the bottom of the calyx, almost universally 4. Ex. Mint, Hyssop, Catmint, Thyme.

Observation. Corolla usually ringent.

2. ANGIOSPERMIA, (ἀγγος *aggos,* a capsule, and σπερμα *sperma*) seeds in a capsule, numerous. Ex. Toad-flax, *Antirrhinum, Chelone* and *Mimulus.*

Observation. The personate flowers belong to this order.

Class 15. *Tetradynamia.*

This, like the last, has but one pistil. It has two orders, both very natural, and distinguished by the form of the fruit.

1. Siliculosa, fruit a silicle *(silicula)* or roundish pod. Ex. Shepherd's purse, *Thlaspi.*

2. Siliquosa, fruit a silique *(siliqua)* or long pod. Ex. Stock-july, Cabbage, Mustard.

The orders of the 16th, 17th and 18th classes, *Monadelphia*, *Diadelphia* and *Polyadelphia*, are founded on the number of the stamens, that is, on the characters of the thirteen first classes, and have the same names, Triandria, Pentandria, &c.

Observation. It may appear inconsistent to the student, that there should be *orders* Triandria &c. when there are *classes* of the same name; but he will observe, that these are orders of *classes*, which have their character not from the *number* of stamens, but from some other circumstance; in the classes above, from the *union of the filaments*, the *number* of the stamens being unappropriated is taken to characterize their orders.

Class 19. *Syngenesia.*

Observation. The orders of this great natural class are frequently complained of, as being difficult to be understood. It is true there are a number of particulars relating to compound flowers, which should be attended to by the student, before he can possibly have a clear conception of these orders. Each of these particulars is easy enough in itself; and it is only for want of attention to them that he meets with any difficulty in understanding the orders.

As the class is a very extensive and interesting one, the student is directed to attend to the points alluded to above, in the following

Analysis of Compound Flowers.

1. A COMPOUND FLOWER* is formed by the union of several fructifications or lesser flowers, called florets, placed together upon a common receptacle, and enclosed in a common calyx; each floret being furnished with five stamens, distinct at bottom, but united at top by their anthers into a tube or cylinder, through which passes a style considerably longer than the stamens, and crowned by a stigma or summit with two divisions, that are generally rolled backward like a recurved fork.

2. Each floret has a monopetalous corolla.

* The Class Syngenesia is made up of compound flowers.

The Florets, as it respects their Corollas, are of two kinds.

1. *Ligulate*, having a strap-shaped corolla, ending in three or five teeth, Pl. 16, fig. 1, *a*.
2. *Tubular*, having a tubular corolla divided into five segments at top, *b*.

The Flowers themselves are of three kinds.

1. Compound radiate. Pl. 16, fig. 1. Consisting of two parts; the *disk* or central part of the flower, *c* composed of tubular florets, and the *ray*, the external circle of florets, *d*, which is composed of ligulate florets. In the Sunflower, the disk is brown and the ray yellow. In the Whiteweed, *Crysanthemum*, the disk is yellow and the ray white These flowers are compared to the sun, having his disk and rays.
2. Ligulate. Pl. 16, fig. 2. Made up altogether of ligulate florets, as the Dandelion.
3. Discoid. Pl. 16, fig. 3. Composed entirely of tubular florets, as the Burdock and Thistle.

So far the florets have been described as being perfect, furnished with both stamens and pistils; but these are sometimes separated and found in separate florets in the same flower.

The Florets, as it respects Stamens and Pistils, are of four kinds.

1. *Perfect florets*, having both stamens and pistils.
2. *Barren*, having stamens only.
3. *Fertile*, have pistils only.
4. *Abortive*, destitute of either stamens or pistils, or having none that are effectual.

The orders of this class, *Syngenesia*, are founded on the situation of the several kinds of florets; *perfect*, *barren*, *fertile*, and *abortive*.

1. Polygamia æqualis, florets all *perfect* or united, each having stamens and pistils. Ex. Dandelion, *Leontodon*; Thistle, *Carduus* and *Cnicus*.

Observation. Linnæus applies the term *polygamia* to all the orders of this class, on account of the promiscuous intercommunication of the several kinds of florets in a compound flower.

2. Polygamia superflua, florets of the disk *perfect*, having stamens and pistils; those of the ray *fertile*, having pistils only, but each producing perfect seed. Ex. Camomile, *Anthemis*; Field-daisy, *Chrysanthemum*.

3. POLYGAMIA FRUSTRANEA, florets of the disk *perfect;* those of the ray *abortive,* being either destitute of a pistil, or having only an ineffectual one. Ex. Bluebottle, *Centaurea;* Sunflower, *Helianthus.*

4. POLYGAMIA NECESSARIA, florets of the disk, *barren,* having stamens only; those of the ray *fertile,* having pistils only. Ex. Marygold; Everlasting, *Gnaphalium.*

5. POLYGAMIA SEGREGATA, each floret having a calyx proper to itself, besides a common calyx including them all. Ex. Globe Thistle, *Gundelia.*

Observation. 1. Linnæus had a 6th order, named *Monogamia,* consisting of simple flowers with united anthers, as Violet and *Lobelia;* but as these have no affinity to the compound flowers, and as the union of their anthers is not in every instance constant, they are lately more commonly placed in the 5th class, *Pentandria.*

2. The names of these orders have been translated, as follows: *æqualis,* equal; *superflua,* superfluous; *frustranea,* ineffectual; *necessaria,* necessary; *segregata,* separated.

The orders of the 20th class, *Gynandria,* the 21st, *Monoecia,* and the 22d, *Dioecia,* are distinguished by the characters of some of the classes themselves which precede them, that is, almost entirely by the number of the stamens, and have the same names, as MONANDRIA, DIANDRIA, &c.

CLASS 23, *Polygamia.*

This class has three orders, which are founded on the situation of the stamen-bearing, pistil-bearing, and perfect flowers.

1. MONOECIA, has either perfect and stemen-bearing, or perfect and pistil-bearing flowers, or all these three kinds on the same plant.

2. DIOECIA, has the two or three kinds of flowers, on two separate plants.

3. TRIOECIA, has them on three separate plants. The Fig, *Ficus,* is the only example.

Class 24, *Cryptogamia.*

Observation. The orders in this class are professedly natural. They are four in Linnæus, but we now reckon five.

1. Filices, Ferns. Whose fructification is obscure, and grows either on the back of the leaf, which is thence denominated a frond; or upon a separate frond. Common Brake is an example.

The parts of their flowers are almost entirely unknown. Their fructification proved to be such by producing them from their seeds, consists of the following parts.

1. Involucre, (*involucrum* or *inducium.*) Pl. 3, fig. 10. A membranous patch which covers the capsules.

Observation. The fructification is most commonly in dots or patches, which are frequently in rows upon the back of the leaf; each of these dots or patches consists of an assemblage of capsules, either naked or covered by an *involucrum.*

2. Capsules, Pl. 3, fig. 11, which consist of two valves, Pl. 3, fig. 11, *b.* contain many seeds, and are sometimes furnished with a ring.

3. Ring, (*annulus.*) Pl. 3, fig. 11. *a.* An elastic substance which surrounds the capsule, partially attached by its opposite ends to the two valves of the capsules.

When the capsule is ripe, its valves separate, and the ring, by its elasticity, throws it open, thus scattering abroad the seeds.

Observation. Those furnished with a ring are termed *annulatæ*, those destitute of it, *exannulatæ.*

2. Musci, Mosses. These are really herbs, with distinct leaves, and frequently a distinct stem.

Fructification of the Mosses.

The fertile flowers have the following parts.

1. Calyptra, (*calyptra.*) Pl. 3, fig. 14, *b.* The proper calyx of the mosses, the summit of which performs the office of a stigma. See page 49.

Observation. Smith considers this a species of *corolla*, and its apex, a stigma.

2. Capsule, Pl. 3, fig. 14, *a*. It is of one valve and one cell, opening by a lid.

3. Lid, (*opurculum.*) Pl. 3, fig. 15, *b*. Which is situated on the top and is covered by the calyptra.

Observation. The capsule in most mosses has its orifice closed by a fringe.

4. Fringe, (*peristomium.*) Pl. 3, fig. 15 & 16, *a*. Which is brought into view by removing the lid. It is either simple or double. The number of teeth, remarkably constant in each genus and species, is either 4, 8, 16, 32, or 64.

Observation. 1. This part is a very interesting object in the microscope.

2. The stamens and pistils of mosses are so difficult to be observed, that I believe no distinctions are founded on them. The barren flowers of mosses consist of an indefinite number of nearly cylindrical, almost sessile anthers; the fertile flowers, of one, rarely more, perfect pistils, accompanied by several barren ones. Some few species have the stamens and pistils associated in the same flower, but they are generally separated.

3. Hedwig raised mosses from the seed.

3. Hepaticæ, Liverworts. Their herbage consists of stem, leaf, and fructification, all united, hence called a frond. The capsules are destitute of a lid or *operculum*.

4. Algæ, Flags. In this order the herbage is a frond, sometimes a mere crust, sometimes of a leathery or gelatinous texture. The seeds are imbedded either in the frond itself or in some peculiar receptacle.

To this order belong the seaweeds, &c. as the common weed upon rocks, between high and low water, with blistery swellings, and the green fibrous substance in fresh water; also the *Lichens*, very distinct from the above, examples of which are seen in the green and dark coloured patches on rocks, and in the light green fibrous substance on trees.

5. Fungi, Mushrooms. Pl. 2, fig. 9. These cannot properly be said to have any herbage. Their subsance

is fleshy, generally of quick growth, and short duration, differing in firmness from a watery pulp to a leathery or woody texture. Ex. Common Mushroom, Toadstool, and Puffball. Their seeds are imbedded in their substance.

Tabular View of the Classes and Orders.

CLASS 1. MONANDRIA, 1 stamen, contains 2 orders.
1. Monogynia, having one pistil.
2. Digynia, 2 pistils.*

CLASS 2. DIANDRIA, 2 stamens, contains 3 orders.
1. Monogynia, having 1 pistil.
2. Digynia, 2 pistils.
3. Trigynia, 3 pistils.

CLASS 3. TRIANDRIA, 3 stamens, contains 3 orders.
1. Monogynia, having 1 pistil.
2. Digynia, 2 pistils.
3. Trigynia, 3 pistils.

CLASS 4. TETRANDRIA, 4 stamens, contains 3 orders.
1. Monogynia, having 1 pistil.
2. Digynia, 2 pistils.
3. Tetragynia, 4 pistils.

CLASS 5. PENTANDRIA, 5 stamens, contains 6 orders.
1. Monogynia, having 1 pistil.
2. Digynia, 2 pistils.
3. Trigynia, 3 pistils.
4. Tetragynia, 4 pistils.
5. Pentagynia, 5 pistils.
6. Polygynia, many pistils.

CLASS 6. HEXANDRIA, 6 stamens, contains 6 orders.
1. Monogynia, having 1 pistil.
2. Digynia, 2 pistils.
3. Trigynia, 3 pistils.
4. Tetragynia, 4 pistils.
5. Hexagynia, 6 pistils.
6. Polygynia, many pistils.

* When the pistils are not distinct in all their parts, the number of styles or sessile stigmas is taken for the order.

Class 7. Heptandria, 7 stamens, contains 4 orders.
1. Monogynia, having 1 pistil.
2. Digynia, 2 pistils.
3. Tetragynia, 4 pistils.
4. Heptagynia, 7 pistils.

Class 8. Octandria, 8 stamens, contains 4 orders.
1. Monogynia, having one pistil.
2. Digynia, 2 pistils.
3. Trigynia, 3 pistils.
4. Tetragynia, 4 pistils.

Class 9. Enneandria, 9 stamens, contains 3 orders.
1. Monogynia, having 1 pistil.
2. Trigynia, 3 pistils.
3. Hexagynia, 6 pistils,

Class 10. Decandria, 10 stamens, contains 5 orders.
1. Monogynia, having 1 pistil.
2. Digynia, 2 pistils.
3. Trigynia, 3 pistils.
4. Pentagynia, 5 pistils.
5. Decagynia, 10 pistils.

Class 11. Dodecandria, 12 to 19 stamens, contains 6 orders.
1. Monogynia, having 1 pistil.
2. Digynia, 2 pistils.
3. Trigynia, 3 pistils.
4. Tetragynia, 4 pistils.
5. Pentagynia, 5 pistils.
6. Dodecagynia, 12 to 20 pistils.

Class 12. Icosandria, stamens 20 or more, inserted into the calyx, contains 3 orders.
1. Monogynia, having 1 pistil.
2. Pentagynia, 5 pistils.
3. Polygynia, many pistils.

Class 13. Polyandria, stamens more than 20, inserted into the receptacle, contains 7 orders.
1. Monogynia, having 1 pistil.
2. Digynia, 2 pistils.
3. Trigynia, 3 pistils.
4. Tetragynia, 4 pistils.

5. Pentagynia, 5 pistils.
6. Hexagynia, 6 pistils.
7. Polygynia, many pistils.

Class 14. Didynamia, 2 long and 2 short stamens, contains 2 orders.

1. Gymnospermia, seeds naked.
2. Angiospermia, seeds in a capsule.

Class 15. Tetradynamia, 4 long and 2 short stamens, contains 2 orders.

1. Siliculosa, fruit a short roundish pod.
2. Siliquosa, fruit a long pod.

Class 16. Monadelphia, stamens united by their filaments into one tube, contains 8 orders.

1. Triandria, having 3 stamens.
2. Pentandria, 5 stamens.
3. Heptandria, 7 stamens.
4. Octandria, 8 stamens.
5. Decandria, 10 stamens.
6. Endecandria, 11 stamens.
7. Dodecandria, 12 to 20 stamens.
8. Polyandria, many stamens.

Class 17. Diadelphia, stamens united by their filaments into 2 parcels, contains 4 orders.

1. Pentandria, having 5 stamens.
2. Hexandria, 6 stamens.
3. Octandria, 8 stamens.
4. Decandria, 10 stamens.

Class 18. Polyadelphia, stamens united into more than 2 parcels, contains 3 orders.

1. Dodecandria, having from 12 to 20 stamens inserted on the receptacle.
2. Icosandria, numerous stamens inserted, in several parcels, on the calyx.
3. Polyandria, stamens numerous, more than 20, inserted on the receptacle.

Class 19. Syngenesia, anthers united into a tube, contains 5 orders.

1. Polygamia æqualis, all the florets perfect, having stamens and pistils.
2. Polygamia superflua, florets of the disk perfect, and those of the ray, pistil-bearing.
3. Polygamia frustranea, florets of the disk perfect, those of the ray neuter and abortive.
4. Polygamia necessaria, florets of the disk furnished with stamens only, those of the ray with pistils only.
5. Polygamia segregata, florets all perfect, and each furnished with a proper calyx besides the common calyx.

Class 20. Gynandria, stamens inserted on the pistil, contains 7 orders.

1. Monandria, 1 stamen.
2. Diandria, 2 stamens.
3. Triandria, 3 stamens.
4. Tetrandria, 4 stamens.
5. Pentandria, 5 stamens.
6. Hexandria, 6 stamens.
7. Octandria, 8 stamens.

Class 21. Monoecia, stamens and pistils in separate flowers on the same plant, contains 9 orders.

1. Monandria, 1 stamen.
2. Diandria, 2 stamens.
3. Triandria, 3 stamens.
4. Tetrandria, 4 stamens.
5. Pentandria, 5 stamens.
6. Hexandria, 6 stamens.
7. Polyandria, more than 7 stamens.
8. Monadelphia, filaments united into one body.
9. Polyadelphia, filaments united into more than 2 sets

Class 22. Dioecia, stamens and pistils in separate flowers, situated on separate plants, contains 8 orders.

1. Monandria, having 1 stamen.
2. Diandria, 2 stamens.
3. Triandria, 3 stamens.
4. Tetrandria, 4 stamens.
5. Pentandria ,5 stamens.

6. Hexandria, 6 stamens.
7. Polyandria, many stamens.
8. Monadelphia, filaments united into a tube.

CLASS 23. POLYGAMIA, stamens and pistils separate in some flowers, united in others, either on the same plant, or on two or three distinct ones of the same species.

Observation. Such difference in the essential organs being moreover accompanied with a difference of structure in the other parts of the flower.—*Smith.*

This class contains 3 orders.

1. Monoecia, united flowers, accompanied with barren or fertile, or both, all on one plant.
2. Dioecia, the different flowers on two different plants.
3. Trioecia, the different flowers on three different plants.

CLASS 24. CRYPTOGAMIA, stamens and pistils either not well ascertained, or not to be numbered with any certainty ; contains five orders.

1. *Filices*, Ferns.
2. *Musci*, Mosses.
3. *Hepaticæ*, Liverworts.
4. *Algæ*, Flags.
5. *Fungi*, Mushrooms.

CHAP. II.

GENERA AND SPECIES.

I. *Genera and their Characters.*

1. A GENUS consists of a number of plants which agree with each other in their flower and fruit.—*Willdenow.*

A genus comprehends one or more species, so essentially different in formation, nature, and often many adventitious qualities, from other plants, as to consti-

tute a distinct family or kind, no less permanent, and founded in the immutable laws of the creation, than the different species of such a genus.—*Smith.* Take, for example, the various species of Rose; these compose a beautiful genus, known to the most ignorant, merely by a certain combination of ideas, which he is unable to express, but which is clearly distinguished by a definite character, which, in the present instance, consists, principally in the urn-shaped calyx, the enlargement or swelling below the flower. The Violets form, also, a beautiful genus, and the Lilies another. Other familiar examples of genera occur in the several families of Oaks, Pines, Cherry trees, Willows and Birches.

2. A genus is aptly compared to a family, and has one name, called the *generic name*, applied to all the individuals composing it, while each individual or species has, in addition, its own peculiar name, called the *specific name*; thus we have *Lilium Canadense*, *Lilium Philadelphicum*, &c.

3. A genus may consist of one species only, although it is commonly composed of more. Ex. *Linnæa* is the only species of its genus.

4. Genera are as much founded in nature, as the species which compose them.

Observation. 1 Although naturalists assume characters, and form artificial divisions as they please, yet they all agree nearly in the genera, which are sufficiently marked by nature.

5. Plants of the same genus possess similar medicinal powers.

Observation. This is in general true, yet there are so many exceptions that "the final appeal must be to experience." Although their properties may be similar *in kind*, yet very different effects may be produced, by the different *degree* in which they possess these properties.

Generic Characters.

THE GENERIC CHARACTER is that mark or set of marks which distinguishes one genus from all others.

1. *The genric characters are taken exclusively from the seven parts of fructification.*

Observation. 1. This is a rule of the first importance in scientific botany, and should be kept in view by the student from the very commencement of his studying genera. To the discovery and observance of this rule, botany owes its very existence as a science. Linnæus first insisted on generic characters being exclusively taken from the seven parts of fructification, and he demonstrated these to be sufficient, for all the plants that can be discovered.

2. The most important characters are afforded by those parts of plants which are most essentially concerned in the reproduction of the species, as the flower and fruit ; it follows then, that plants which agree in these, whether they agree in other points, or not, are allied ; and those which do not, are fundamentally different.

2. Generic characters are drawn from the *number, figure, situation, proportion,* and *connexion* of each particular part of the fructification.

Observation. 1. Thus all the different species of *calyx, corolla, nectary, pericarp,* &c. considered with respect to the five attributes just mentioned, furnish the observer with so many simple characters. These simple characters Linnæus denominates the letters or alphabet of botany. By studing, comparing, and, as it were, spelling these letters, the student comes at last to read and understand the generic characters, which the Creator has originally imprinted upon vegetables.—*Milne.*

2. Some characters are more uniform and constant than others; the parts of the flower and fruit are more constant than the other parts of a plant; and again, the *situation, connexion,* and *proportion* of these parts, more constant than the *number* and *figure.*

Colour is in general so variable, that it is not depended on as a character, either of genera or species.

3. In some few genera, *all* the parts of the flower and fruit are constant and uniform, as the Lily, Rose, Violet, Iris, &c.

4. In others, a *part* only of the fructification is uniform and constant.

5. The part that is uniform and constant in all the species of the genus, is various in various genera. In the genus *Anemone,* it is the seeds, while the petals vary from 5 to 9. In the genus *Acer,* Maple, it is the peculiar seed-vessel, furnished with a dilated wing, while the other parts are inconstant. In *Hydrophyllum,* it is the closed chinks, which are situated within the corolla.

By taking into the generic character a greater or less number of marks, Linnæus himself makes several kinds of generic characters. The most important are the *Natural* and the *Essential*.

1. *The Natural character* comprehends every possible mark, common to all the species of one genus; is an enumeration of all the particulars in which their fructifications agree.

2. *The Essential character* consists of an enumeration of those marks only, which distinguish the genus from all others. This last, is the kind of generic character now universally adopted, and indeed the only one in common use. The excellence of the essential character consists in its brevity and perspicuity. In ten or twelve words, it frequently makes know the distinguishing marks.

The natural character is much more lengthy, and does not direct the attention, particularly, to those essential marks which distinguish the genus. It is used by Linnæus in his *Genera Plantarum*, a work now nearly superseded by the *essential characters*, in his *Systema Vegetabilium*, and therefore, in some measure laid aside. Both the *Natural* and *Essential* characters are put down in the Cyclopedia.

Observations. The study of genera cannot be too strongly recommended to the young Botanist. The science of Botany may be said to consist principally in a knowedge of them, and the whole use of the Classes and Orders, is to afford a facility, by which to arrive at this knowledge. When a Botanist has become acquainted with a single species of a genus, and by examining its flower and fruit, fixed in his mind the character of the genus, he is enabled to recognize all the other species, which, in some instances, are hundreds, wherever he may meet with them. This serves to give some idea of the pleasures and advantages of a knowledge of genera.

But it is not from *books* alone that this knowledge is to be obtained; the student should study *plants themselves;* he should make nature *principal*, and books *auxiliary* In Botany, as well as in every other branch of Natural History, the objects themselves should be studied, and books be used as a mere assistance.

The few rules given above concerning genera and their characters can hardly be comprehended without some practical observation.

Whenever the young botanist has an opportunity, he should examine the several species of the same genus, and see how the generic character appears in each.

He should also compare the characters of different genera. By repeated efforts of this kind, he will finally become acquainted with the various *affinities* of plants, by which species are united into Genera, and Genera again into Natural Orders, by which all the individuals of the vegetable kingdom sustain a beautiful and varied relation to each other.

II. *Species.*

1. SPECIES are the individuals of which a genus consists.

A species more properly consists of a number of individuals, all of which are essentially alike ; called different specimens of the same species ; for example, in one orchard are several Apple-trees, which are so many individuals of the same species, *Pyrus Malus.*

2. Any permanent peculiarity is sufficient to constitute a species.

Observation. If one plant in a genus had round leaves, while all the rest had leaves of some other form, such plant would constitute a distinct species.

THE SPECIFIC CHARACTER consists of those marks which distinguish one species from all others in the genus.

Specific characters are taken from the *number, figure, situation, proportion* and *connexion* of the roots, trunks, leaves, and appendages ; also from the inflorescence, and such circumstances of the flower and fruit as are not appropriated to the other divisions.

Observation. 1. The most permanent characters are furnished by those circumstances of a plant which are most essentially concerned in its existence or peculiar habits. Thus the strong curved prickles of the Sweet-briar Rose are necessary to support this "towering queen" on other plants, and are therefore constant and uniform, while in other species of Rose, in which the prickles have no very essential part to serve, they are variable.

2. Colour, although so conspicuous a mark in flowers, is so variable, that it is never depended on as a character.

Take, for an example of *Generic* and *Specific* characters, the family of Lilies, which in *Practical Works* is arranged as follows.

Class VI. HEXANDRIA, *six stamens.*

Order I. *MONOGYNIA, one style.*

Genus LILIUM. *LILY.*

Generic character. Calyx none; corolla inferiour, six petalled, the petals with a longitudinal groove from the middle to the base.

Species 1. LILIUM CANADENSE. *Canada Lily. Common Yellow Lily.*

Specific Character. Leaves in whorls; flowers terminal, drooping, petals spreading.

Species 2. LILIUM PHILADELPHICUM. *Common Red Lily.*

Specific Character. Leaves in whorls; flowers erect; corolla bell-shaped, petals with claws.

Observation. 1. The Cabbage, Turnip, and Kale, are so many species of one genus, *Brassica.* The Apple, Pear, and Quince, of the genus *Pyrus.* The Plum and Cherry are species of the genus *Prunus.* The Currant and Gooseberry are species of *Ribes.*

2. A *diagnostic* or *discriminating description* of a plant, of which the above is an example, is liable to differ very much from a *general* or *entire description.* In a *discriminating* description such points only are noticed as are sufficient to distinguish the plant successively, in classes, orders, genera, and species from all others. In distinguishing species especially, very minute marks are frequently of necessity made essential, because they are the only definable points in which the species differs from all others, while some marks which are prominent, pass unnoticed because they are common to several.

A *perfect* or *complete description* of an individual, made out without any reference to other plants, touches every point and gives, as it were, a complete picture of the whole plant. Such a description has been called the *Natural Character* of the *Species.*

It is often very convenient to note down something like an entire description of plants, as we find them, in order to retain their characters until we can find their distinguishing description, or in other words, their generic and specific characters.

It is very well calculated to improve a young botanist to attempt an entire description of all the parts of a plant in technical terms. By repeated attempts of this kind, the language of botany will become familiar.

The order to be observed in such descriptions, is that of nature, as follows: beginning with the ROOT, then the TRUNKS, LEAVES, APPENDAGES, INFLORESCENCE, FRUCTIFICATION, &c. In describing the fructification, begin with the external part, and proceed inward, thus, first the *calyx*, then the *corolla*, &c The description of each separate part should be arranged in a separate paragraph.

The Characters of the Classes are taken from the stamens; those of the Orders from the stamens and pistils, principally from the pistils; the Generic Characters from the other of the seven parts of fructification and such circumstances of the stamens and pistils as are not taken for the Classes and Orders; and the Specific Characters from all parts of the plant except such circumstances of the flower and fruit as are taken for Classes, Orders, and Genera.

VARIETIES, (*varietas*) are plants changed from their usual appearance by some accidental cause; the various kinds of Apples are examples of varieties. See page 5.

Observation 1. As many plants of different form and appearance as are produced from seed of the same species, are to be regarded as genuine varieties, and in all cases to be distinguished with great care from the species.

2. Varieties are caused by culture, climate, exposure, age, disease, luxuriance or poverty of nourishment, and some other causes.

3. Gardeners by various methods of culture produce innumerable varieties, especially of double flowers.

4. Varieties in colour are very common.

We have now explained the terms of botany, as applied to the external forms of plants, illustrated the Classes and Orders of Linnæus, and given a brief outline of Genera and Species; an understanding of which is all that is necessary for discriminating plants. It remains to explain

The method to take to find out an unknown plant.

Observation. As the most important distinctions are founded on the flower, the only proper time for examining a plant is when it is in flower.

When a botanist has obtained a plant in flower, he determines, in the first place, by inspecting the flower, to what class it belongs, and to what order in that class. He next refers to some practical work, such as Dr. Bigelow's "Plants of Boston," Eaton's "Manual," or Pursh's "Flora," in which the plant is presumed to be described, and turns to the class and order pointed out by the flower. Next reads over the generic characters in that order, carefully observing the particulars of the fructification mentioned, until one is found which applies. This gives him the generic or family name which is prefixed to the character. Lastly he turns to the specific characters of the genus, reads them over, and observes the particulars mentioned until he finds the one which applies. To this is prefixed the specific name. Thus he discovers the technical name of the individual; which was the object. This is generally accompanied with the *synonims*, one or more English names, and references to figures.

By means of the name he is enabed to refer to whatever may have been written concerning it. And also to refer to its place in the Natural Orders, and thus see to what other genera it is allied.

To be convinced of the great utility of an artificial system in conducting to the knowledge of plants, let us suppose the number of known species of plants to be twelve thousand, and the number of classes in a certain known method, to be twenty-four. A plant is presented to me which I have never seen. I immediately look for the general character, which serves to distinguish each of the twenty-four classes. This being found, and consequently the class of the plant being determined, I have no longer to look for my plant among twelve thousand, but, on a supposition that each class contains an equal number, among five hundred only the twenty-fourth part of the number just supposed. I next look for the character of the order, the second division, which being likewise found, will reduce the number to about an hundred. The character of the genus, which I next explore, will reduce the number still further, to twenty, for instance, that of the species determines the plant in question.

This method of proceeding is similar to that which is observed in turning over a dictionary, where, in searching for a word, as FAME, we first look for the letter F, then A, and so successively the M and E. F may represent the class, A the order, M the genus, and E the species.—*Milne.*

Observation. 1. It happens in some instances in the Linnæan system, that a particular species has the character of some other class or order than the one to which the other species of the same genus belong. Thus the Fringed Gentian has only four stamens, while the other species of the genus have 5. Some species of *Cerastium* have only 4, others 5, stamens, though the greater part have 10. This is an imperfection in the classes and orders, and as the different species of the same genus must never be separated by artificial arrangements, such species are not placed in the class and order whose character they have, but are retained with the other species of their genus in another class and order. Their names however are put down in italics by Linnæus in the class and order to which they would be referred by the stamens and styles. This obviates the difficulty which would otherwise arise to the student, and enables him to refer to the plant by the index.

2. There is generally a relation in the *numbers* of the different parts of the same flower. Thus the Lily has 6 petals, 6 stamens, stigma 3-cleft, capsule 3-celled. The Rose has its calyx 5-parted and corolla 5-petalled. In *Trillium* this uniformity of numbers is so remarkable as to give name to the genus. It has 3 leaves; the flower has the calyx 3-leaved, corolla 3 petalled, stamens 6, stigmas 3, capsule 3-celled.

This often gives a clue to the class and order of an unknown plant when it is in fruit. The benefit of which I have frequently had the satisfaction to avail myself of, either by the divisions of a permanent calyx, the number of valves or cells of the capsule or the number of seeds.

3. Sometimes from poverty of nourishment or some other cause, flowers are found to have a less number of divisions in all their parts than usual; or a greater number from abundance of nourishment.

The *Epigæa* usually has its calyx and corolla 5-parted, stamens 10, capsule 5-celled; but some of its flowers occasionally have a fifth part wanting, thus: calyx and corolla 4-parted, stamens 8, capsule 4 celled.

4. In some plants the terminal flowers have a greater number of divisions than the latteral ones. Ex. Some species of *Monotropa* have their terminal flowers with 10 petals, 10 stamens, capsule 5-valved, &c. while the lateral ones have a fifth part wanting, thus: petals 8, stamens 8, capsule 4-celled, &c.

The student will observe that the genera in each order of Linnæus are arranged according to their natural affinities; thus combining, as far as may be, the advantages, both of a Natural and an Artificial method.

It has already been observed, that plants which agree in their most essential external characters, agree also in their properties. Of course certain qualities will be indicated by particular external marks—See page 80 & 91. Upon this principle are constructed the following

Rules to distinguish Poisonous Plants.

1. Plants with glumes, as the grasses, never poisonous. They belong mostly to *Triandria*

2. Plants with 5 stamens and 1 pistil, Pentandria, Monogynia, of a dark gloomy aspect and nauceous smell, are narcotic and dangerous. Ex. Thorn-apple, *Datura;* Henbane, *Hyoseyamus;* Tobacco, *Nicotiana*

3. Plants of *Pentandria Digynia*, bearing umbels, are poisonous if they grow in wet soil and have a nauceous odour; Ex. Hemlock, *Conium;* Water parsnip, *Sium;* Water-hemlock, *Cicuta.*

Observation. The *cicuta maculata* is an exception to a part of the rule, being *aromatic* and still a deadly poison. It is on that account the more dangerous. It has destroyed some children lately, the root being mistaken and eaten by them for Angelica.—See Dr. Bigelow's Medical Botany.

If they grow on dry soil and have an agreeable odour, they are healthful aromatics, as Coriander, Carui, Fennel.

4. Plants with stamens inserted on the calyx, whether they be few, as in the Currant, or numerous, as in the class *Icosandria*, have wholesome fruits, as Apple, Plum, Strawberry, Currant. The other parts of the plant should be suspected.

5. Plants with rngent corollas and naked seeds are mostly aromatic, and none of them poisonous, as Sweet Marjoram, Catmint, Hyssop, Motherwort. They belong chiefly to *Didynamia Gymnospermia*

6. Plants with labiate corollas, and seeds in a seed-vessel, are, in some instances, narcotic, as Fox-glove, *Digitalis.* They belong to *Didynamia Angospermia*, and have generally personate flowers.

7. Plants of the 15th Class, *Tetradynamia*, having cruciform flowers, rarely, if ever, poisonous, but are many of them used as food; as Cabbage, Turnip, Radish, and Mustard

8. Plants with butterfly-shaped flowers, belonging mostly to *Diadelphia*, very rarely poisonous; many of them are used for food; as Pea and Bean. Wild Indigo, *Podalyria tinctoria*, is an exception, being emetic and cathartic.

9. Plants of the 19th Class, *Syngenesia*, having compound flowers, are rarely poisonous; as Sunflower, Dandelion and Thistle.

10. Plants which have a milky juice, unless compound, are poisonous; as Dog's-bane, *Apocynum;* Milkweed, *Asclepias.*

11. Plants having any appendage to the calyx or corolla, and 8 or more stamens, generally poisonous; as Columbine, *Aquilegia;* Monk's-hood.—See Eaton's Manual, page 11.

We have now gone through with what is necessary to become acquainted with genera and species, in a knowledge of which Botanical science principally consists. The next chapter contains some observations on Natural Orders, and the general relations of plants, of which the student cannot possibly form a very definite conception, until he is more or less acquainted with genera. It is well enough however for him to read them, but he must not be dissatisfied with himself or discouraged if he does not at once understand them in every particular.

CHAP. III.

Natural Orders.

A NATURAL ORDER consists of a number of genera, which are allied to each other by botanical affinities; which have an evident agreement with each other in some of their most essential parts.

In a *Natural Method* the *Artificial Divisions, Classes* and *Orders* are set aside and the vegetable kingdom stands divided, first into those primary divisions, Natural Orders, which nature has marked out. These are divided, in the next place, as artificial classes and orders are, into genera; and the genera into species.

The *Artificial arrangement* of the vegetable kingdom into Clases and Orders, for the purpose of determining the name and history of an unknown plant in an easy and direct manner, was thought by Linnæus to be a matter of necessity; because *Natural Orders* cannot be stamped with a single definite character by which the individuals of each might be readily known. But still he considered a *Natural method* as the perfection of Botanical science.—See page 64.

Take a fruit garden for an example of a natural order. The Cherry and Plum are two species of the genus *Prunus;* Peach and Flowering Almond, two

species of *Amygdalus;* Pear, Apple and Quince, three species of *Pyrus;* Currant and Gooseberry, two species of *Ribes.* These all belong to the same Natural Order, POMACEÆ of Linnæus.

Observation. The relation between these several genera is obvious even to a common observer, by their habit* or general aspect.

These relations may be represented in the following manner:

NATURAL ORDER.	GENERA.	SPECIES.
POMACEÆ.	*Prunus.*	Cherry,
		Plum.
	Amygdalus.	Flowering Almond,
		Peach.
	Pyrus.	Pear,
		Apple,
		Quince.
	Ribes.	Currant,
		Gooseberry.

There is a tendency in the vegetable kingdom towards the following general relations, upon which Natural Divisions, such as *Natural Orders, Genera,* &c. are founded.

1. All the individuals which compose it are united by affinities into one common bond, in which there is a gradual transition from one point to another, the various individuals standing as so many points of an extended series, or so many links of a continued chain. Thus one plant has a certain set of characters; another loses some of these and acquires some new ones; another loses some more, and acquires other new ones, &c. until the two extremes are quite different from each other.

2. In this general series Natural Orders are related to each other. The various Genera of the same natural order are related on one extreme with one natural order, and, passing through a gradual series, approach

* By *habit* in botany is meant the general port or appearance of a plant, which strikes the observer at once, and cannot be very well defined.

another on the other extreme. Some genera seem to hold an intermediate place between two orders.

3. The various species of the same genus are in the same way allied, on one extreme, to one genus, and, on the other, to another.

Although there is an evident tendency to the above conditions, yet they are not universally true. They require to be very much modified, as follows :

1. The relations, of genera particularly, in the series, instead of being single and simple as above, are, in many cases, compound and complicated. Thus a plant is not only allied in certain points to those which are considered next to it, but it is related in other points to various other plants, holding a place more remote in the series.

If we represent the series of relations by a chain, it would not consist of single, simple links, but the links in different parts, would be variously looped together.

2. The series is variously interrupted ; in many instances some links appear to be wanting. Many plants are not connected at all and constitute solitary links.

Observation. Naturalists have an opinion that these deficiences do not really exist in nature, but are occasioned by our partial knowledge of the vegetable kingdom. This leads to the conclusion, that a large portion of the vegetable world lies yet unexplored, and attaches additional importance to new discoveries.

3. Some natural orders are strikingly marked, all their genera being very similar among themselves, and evidently distinct from all others, scarcely showing any tendency to a gradual transition from one point to another. Such are the Grasses, Umbelliferous plants, and Compound flowers.

4. Many genera are no less strikingly natural, the species holding a very close affinity among themselves, and differing essentially from all other genera, as the genus Rose, and Violet. These are the most perfect examples of genera.

Observation. 1. If the whole vegetable kingdom was in this way distributed into definite natural tribes or classes, the study of botany on such a plan would be easy and satisfactory, and an artificial system would hardly be needed.

2. It was at one time a desideratum with Naturalists to dicover a perfect and complete natural method. Although they have readily done it to a certain extent, yet on account of the difficulties already mentioned above, No. 1 & 2, the natural orders are still in some measure incomplete, and a number of plants remain unassociated.

3. The Linnæan order, *Polygynia,* in Class *Icosandria,* to which belong the Rose, Raspberry, Strawberry, and Cinquefoil, affords one of the most perfect examples possible, of a natural assemblage, of which all the genera are natural, and so well distinguished in habit, that any person, at all observant of plants, may know them by their foliage, inflorescence or general appearance, while their fruit affords clear essential generic characters. The natural family of Orchidæ come very near the same point of perfection, but their differences of habit are less obvious. Such instances ought to stimulate the philosophical Botonist "to go on from one degree of perfection to another," though, like the christian moralist, he cannot hope to reach the summit.—*Smith.*

4. It is impossible for a person to form a proper conception of natural orders until he is acquainted with a number of genera, so that he can bring together their characters and compare them at once in his own mind.

The student of Natural History, who gets introduced to the vegetable kingdom by Linnæus's artificial system, and prosecutes the subject from the *book of nature,* will, independently of any system of natural orders of Linnæus, of Jussieu, or any one else, observe Nature's method, will observe the family affinities of the several plants he becomes acquainted with, thus forming a sort of natural system in his own mind.

Linnæus called his scheme of Natural Orders, *Fragments of a Natural Method.* The Natural Orders of Jussieu are said to be an improvement on those of Linnæus. Those of Linnæus are subjoined, as they are more connected with his artificial system.

Linnæus expresses an opinion, that plants which are allied by botanical affinities, possess similar medicinal properties. The sensible qualities, as taste and scent, must however be regarded.

These give a general indication, but so many qualifications are necessary in particular cases, that the administration of plants as remedies, must still rest on experience. See observation, page 80.

Natural Orders of Linnæus.*

1. Palmæ. Palms and palm-like plants; as Cocoa-nut, *Cocos;* Date-tree, *Phœnix.*

2. Piperitæ. Pepper and other plants agreeing with it in habit and sensible qualities. Indian-turnip, *Arum;* Skunk-cabbage, *Dracontium.*

3. Calamariæ. Grasses with culms without joints; as Sedge, *Carex;* Cat-tail, *Typha.*

4. Gramina. Grasses with jointed culms, and a glume calyx; Wheat, *Triticum;* Rye, *Secale;* Barley, *Hordeum;* Oats, *Avena;* Herdsgrass, *Phleum;* Indian-corn, *Zea.*

5. Tripetaloidæ. (*Tres*, three, and *petalum*, a petal.) Plants with three petals; as Water-plantain, *Alisma;* Rush, *Juncus;* Arrow-head, *Saggittaria.*

6. Ensatæ. (*Ensis*, a sword.) Plants with sword-shaped leaves; as Flower-de-luce, *Iris;* Blue-eyed grass, *Sisyrinchium;* Virginian Spider-wort, *Tradescantia.*

Observation. Very nearly allied to the grasses and liliaceous plants.

7. Orchideæ. Roots fleshy; leaves sessile, nerved; flowers irregular, five petalled, gynandrous; pollen glutinous; germ inferiour; as *Orchis;* Ladies' slipper, *Cypripedium; Arethusa; Cymbidium.*

8. Scitamineæ (*Scitamentum*, a dainty.) Consists of plants which furnish exquisite fruits, and of others which have an agreeable aromatic flavour; as Banana, *Musa;* Ginger, *Amomum.*

9. Spathaceæ. Corolla liliaceous, calyx a spathe; as Onion, *Allium;* Daffodil, *Narcissus.*

10. Coronariæ. (*Corona*, a wreath.) Liliaceous

* Mr. Eaton, in his Manual of Botany, 2d ed. has given the Natural Orders of Linnæus and the qualities of each; and also the Natural Orders of Jussieu, with a catalogue, under each, of the genera belonging to it.

plants without spathes; as Lily, *Lilium;* Tulip, *Tulipa;* Crown-Imperial, *Fritillaria;* Hyacinth, *Hyacinthus; Hypoxis;* Pine-apple, *Bromelia.*

11. SARMENTACEÆ. (*Sarmentum*, a shoot. Corollas liliaceous, stems weak or climbing. *Asparagus; Smilax;* Solomon's seal, *Convallaria;* Adder's-Tongue, *Erythronium.*

12. HOLERACEÆ. (*Holus*, pot-herbs.) Consists of plants used for culinary purposes; as Beet, *Beta;* Rhubarb, *Rheum;* Dock, *Rumex.*

Observation. Flowers generally small and destitute of beauty.

13. SUCCULENTÆ. Flat, fleshy, succulent plants, most of which are evergreen; as Prickly-pear, *Cactus;* House-leek, *Sempervivum;* Purslain, *Portulacca.*

14. GRUINALES. (*Grus*, a crane.) *Geranium* and its relatives. Flowers 5-petalled, seed-vessels generally 5 cornered and beaked. *Geranium;* Flax, *Linum;* Wood-sorrel, *Oxalis.*

15. INUNDATÆ. Plants growing under water; as *Hippuris; Potamogeton.*

16. CALYCIFLORÆ. (*Calyx*, & *flos*, a flower.) Corollas wanting, stamens on the calyx, fruit pulpy; as Seed Buckthorn, *Hippophaæ;* Poet's Cassia, *Osyris.*

17. CALYCANTHEMÆ. (*Calyx*, & ἄνθος, a flower.) Corolla and stamens inserted into the calyx; as Willow-herb, *Epilobium;* Primrose, *Œnothera.*

18. BICORNES. (*Bis*, two, & *cornu*, a horn.) Plants with horned anthers; as Whortle-berry, *Vaccinium; Andromeda;* Partridge-bush, *Gaultheria.*

19. HESPERIDÆ. (*Hesperides*, whose orchards, according to the poets, produced golden fruits.) Golden or precious fruit. Aromatics. Calyx permanent superiour, stamens inserted into it; as Clove-tree, *Caryophyllous;* Allspice, *Myrtus;* Mock-orange or Syringa, *Philadelphus.*

20. ROTACEÆ. (*Rota*, a wheel.) Corolla wheel-shaped. Rock-rose, *Cistus;* St. John's wort, *Hypericum.*

21. Preciæ. (*Precius*, early.) *Primula*, and a few genera allied to it in habit, though not always in the character expressed in the title; as *Diapensia*; Bog-bean, *Menianthes*.

22. Caryophyllei. (*Caryophyllus*, a pink.) Corollas pink-like, branches opposite, axillary, leaves opposite. Pink, *Dianthus*; Cockle, *Agrostemma*; Chickweed, *Stellaria*.

23. Trihilatæ. (*Tres*, three, & *hilum*, the eye of the seed.) Plants with 3 seeded capsules, seeds marked with a hilum or scar. Bead-tree, *Melia*; Maple, *Acer*; Horse-chesnut, *Æsculis*; Nasturtion, *Trapæolum*.

24. Corydales. (κορυς, a helmet.) Plants with peculiar irregular corollas, somewhat resembling a helmet. Fumitory, *Fumaria*; Balsam, *Impatiens*.

25. Putamineæ. (*Putamen*, a shell.) Consisting of plants whose fleshy seed-vessel is frequently covered with a hard woody shell. Caper-bush, *Capparis*; Calabash-tree, *Crescentia*.

26. Multisiliquæ. (*Multus*, many, & *siliqua*, a pod.) Plants having many dry capsules or numerous distinct naked seeds. Columbine, *Aquilegia*; Lark's-spur, *Delphinium*; Buttercup, *Ranunculus*; *Anemone*.

27. Rhœadeæ. (*Rhœas*, Red Poppy.) Plants with caducous calyxes; containing a red or a milky juice. Poppy, *Papaver*; Bloodroot, *Sanguenaria*; Celandine, *Chelidonium*.

28. Luridæ. (*Luridus*, dark gloomy.) Corollas monopetalous, flowers pentandrous or didynamous, with superiour capsules. Thorn-apple, *Datura*; Foxglove, *Digitalis*; Tobacco, *Nicotiana*; Nightshade, *Solanum*.

29. Campanaceæ. (*Campana*, a bell.) Flowers more or less bell-shaped; as *Campanula*; *Convalvolus*; *Lobelia*; Violet, *Viola*.

30. Contortæ. (*Con*, together, & *torqueo*, to twist.) Corollas twisted. Periwinkle, *Vinca*; Dog's-bane, *Apocynum*; Milkweed, *Asclepias*.

31. VEPRECULÆ. (*Vepres*, a bramble.) Corollas monopetalous, coloured; berry superiour, one-seeded. Mezereon, *Daphne;* Leather-wood, *Direa.*

32. PAPILIONACEÆ. (*Papilio*, a Butterfly.) Flowers butterfly-shaped. Bean; Pea; Locust-tree, *Robinia;* Clover, *Trifolium.*

33. LOMENTACEÆ. Corollas not perfectly butterfly-shaped. Stamina distinct, fruit leguminous; as *Cassia;* Sensitive plant, *Mimosa;* Milk-wort, *Polygala.*

34. CUCURBITACEÆ. (*Cucurbita*, a gourd.) Gourd-like plants; as Pumpkin, *Cucurbita;* Cucumber and Melon, *Cucumis;* Passion-flower, *Passiflora.*

35. SENTICOSÆ. (*Sentis*, a briar.) Prickly plants. Mostly Pentapetalous and Icosandrous. Raspberry; Strawberry; Rose; Avens, *Geum;* Cinquefoil, *Potentilla.*

Observation. Nearly allied to POMACEÆ.

36. POMACEÆ. (*Pomum*, an apple.) Plants with a pulpy, esculent fruit; as Apple and Pear, *Pyrus;* Currant; Peach; Plum.

37. COLUMNIFERÆ. (*Columna*, a pillar, & *fero*, to bear.) Plants whose stamens and pistils have the appearance of a column or pillar in the centre of the flower. Hollyhock, *Alcea;* Mallows, *Malva.*

Observation. Many of them monadelphous.

38. TRICOCCÆ. (τρεις, three, & κοκκος, a grain.) Capsule 3-cornered, 3-celled, cells 1-seeded; as Box, *Buxus;* Palma-Christi, *Ricinus.*

39. SILIQUOSÆ. (*Siliqua*, a pod.) Flowers cross-shaped. Tetradynamous, seed-vessel a silique. Radish; Mustard; Cabbage.

40. PERSONATÆ. (*Persona*, a mask.) Flowers personate; as Toad-flax, *Antirrhinum;* Snake's-head, *Chelone.*

41. ASPERIFOLIÆ. (*Asper*, rough, & *folium*, a leaf.) Leaves rough. Corolla monopetalous, stamens 5,

seeds 4, naked. Borage, *Borago ;* Comfrey, *Symphytum.*

42. VERTICILLATÆ. (*Verticillus*, a whorl.) Flowers in whorls, corollas labiate, as Hyssop ; Mint ; Marjoram, *Origanum ;* Sage, *Salvia ;* Thyme, *Thymus.*

43. DUMOSÆ. (*Dumus*, a bush.) Bushy plants, with small flowers. Stamens 4, 5, 6 or 10. Elder, *Sambucus ;* Sumach, *Rhus ;* Snowball, *Viburnum ;* Staff-tree, *Celastrus ;* Holly, *Ilex.*

44. SEPIARIÆ. (*Sepes*, a hedge.) Ornamental shrubs, with few stamens. Lilac, *Syringa ;* Privet, *Ligustrum.*

45. UMBELLATÆ. Flowers in umbels, corollas 5-petalled, stamens 5, styles 2, seeds 2 naked. Carrot ; Parsnip ; Carui.

46. HEDERACEÆ. (*Hedera*, Ivy.) Petals 5, stamens 5, fruit berry-like. Vine, *Vitis ; Aralia ;* Ginseng, *Panax.*

47. STELLATÆ. (*Stella*, a star.) Leaves whorled, seeds 2, naked. Dogwood, *Cornus ;* Madder, *Rubia ; Galium.*

48. AGGREGATÆ. (*Aggregare*, to assemble.) Flowers aggregate ; as Teazel, *Dipsacus ; Boerhaavia.*

49. COMPOSITÆ. Compound flowers ; as Dandelion ; Thistle ; Sunflower.

Observation. Belonging to class *Syngenesia.*

50. AMENTACEÆ. Bearing aments ; as Oak ; Chesnut ; Willow ; Alder.

Observation. Principally trees.

51. CONIFERÆ. Consisting of cone-bearing plants ; as Pine, Hemlock-tree, and Spruce, *Pinus ;* Juniper, *Juniperus ;* Cedar, *Cupressus.*

Observation. Mostly trees.

52. COADUNATÆ. (*Coadunare*, to join together.) Several seed-vessels united somewhat at their base,

forming a sort of cone ; as Tulip-tree, *Liriodendron ; Magnolia.*

53. SCABRIDÆ. (*Scaber*, rough.) Leaves rough, flowers destitute of beauty ; as Elm ; Nettle ; Hop ; Hemp.

Observation. Rougher than those of the 41st order, *Asperifoliæ.*

54. MISCELLANEÆ. Plants unconnected.

55. FILICES. Ferns, Brakes, Polypod, &c.

56. MUSCI. Mosses.

57. ALGÆ. Flags, Liverworts, Lichens, and Sea-weeds.

58. FUNGI. Mushrooms.

Observation. These four last constitute the Linnæan class *Cryptogamia*, which see.

PART V.

Anatomy and Physiology of Vegetables.

This comprehends an account of the internal organs, and the functions they perform.

Plants are organic bodies, containing cells, vesicles, absorbents, tubes, &c. which being disposed in regular order and qualified with the principle of vitality, are the laboratory in which nature produces the phenomena of vegetation.

Plants as well as animals then are endowed with the principle of life or vitality, a principle which minerals do not possess; "they are living organized beings."

If it be asked what this principle of life or vitality is, we must own our complete ignorance. We know it, as we know its omnipotent Author, by its effects.

The effects of vitality are stupendous beyond conception, in the operations constantly going on in every organized body, from our own elaborate frame to the humblest moss or fungus.

Those different fluids which compose the eye, so fine and transparent, separated from each other by membranes as fine, all retain their proper situations (though each fluid individually is perpetually removed and renewed) for sixty, eighty, or an hundred years or more, while the principle of *life* remains.

So do the infinitely small vessels of an almost invisible insect, the fine and pellucid tubes of a plant, all hold their destined fluids, conveying or changing them according to fixed laws, but never permitting them to run into confusion so long as the vital principle animates their various forms. But no sooner does *death* happen, than without any apparent alteration of structure, any apparent change in their *material* configuration, all is reversed. The eye loses its form and brightness; its membranes let go their contents, which mix in confusion, and thenceforth yield to the laws of chemistry alone. Just so it happens, sooner or later, to the other parts of the animal as well as vegetable frame.

Chemical changes, putrefaction and destruction immediately follow the total privation of life, the importance of which instantly becomes evident when it is no more.

I humbly conceive therefore, that if the human understanding can, in any case, flatter itself with obtaining in the natural world, a glimpse of the *immediate agency* of Deity, it is in the contemplation of this *vital principle*, which seems independent of material organization, and an impulse of his own divine energy.—*Smith.*

CHAP. I.

GERMINATION.

GERMINATION is a term applied to that part of vegetable physiology, which explains the process by which a seed becomes a plant.

For the terms applied to the various parts of a seed, see p. 59.

When a seed is committed to the earth, under the proper conditions of air, heat, and moisture, it first swells by the fluids absorbed by its vessels. According to Dr. Thomson of Edinburgh, a chemical action next takes place; oxygen gas is absorbed, and carbonic acid evolved; by this process, the carbon in the farina of the lobes being diminished, and the oxygen increased in proportion, it is, in part, converted into sugar. The cotyledons thus prepared, convey nourishment through vessels, fitted for the purpose, immediately to the embryo or chick. Thus supplied with nourishment, the chick sends its radicle downward, taking such root as finally to be supplied with nourishment from the earth, and its plume upward, to unfold itself into herbage. In this process, the integuments of the seed are ruptured and presently decay. The radicle makes its appearance rather before the plume.

Observation. The chemical action, mentioned above, is attended with an evolution of heat which results from the absorption of oxygen

The evolution of sugar is precisely what takes place in malting, in which the seed is exposed in a warm place and moistened until germination commences, when the process is stopped by drying it. It is then found to have become sweet, and is used to impart saccharine matter to beer.

When the young root has made some progress, the cotyledons are raised out of the ground by the ascending stem, take a green colour and perform the function of real leaves, submitting the juices to the action of air and light; in this state they constitute what are called *seed-leaves*. Radish, Mustard, and Bean are examples. After the plume unfolds itself into the proper leaves, these seed-leaves, being no longer needed, generally wither and decay.

Plants which have only one cotyledon, as the grass and corn tribes, and the *Orchidæ*, do not raise it out of the ground, and it of course never becomes a seed-leaf.

Observation. The substance, which makes up the principal bulk of the seed with one cotyledon, has been called *Albumen*. There is, in some of those seeds, another part, which is situated in immediate contact with the embryo, which has been called *Vitellus* or yolk, very conspicuous in Indian-corn.

The presence of air is indispensable to the germination of seeds. They will not vegetate in an exhausted receiver, nor when they are buried too deep in the earth, but they often retain their power to vegetate for an unlimited period. Earth, taken from a considerable depth, will, when exposed to the air, soon be covered with young plants, especially of the Thistle or Mustard kind, though no seeds have been allowed to have access to it.

The vital principle of seeds, on which depends their power to vegetate, seems not to be affected by the common vicissitudes of heat and cold. Some seeds lose their vegetative power by being kept out of the ground ever so little a while after they are ripe, and, in order to succeed, must sow themselves in their own way. Others may be kept a long while without losing this power. Some seeds, although they will vegetate after being long preserved, yet they produce stinted and sickly plants.

If the process of germination has once commenced, its interruption is fatal to the seed.

The elongation of the radicles downward takes place by additions to their extremities. The elongation of the plume takes place by an increase of parts already formed.

The unerring direction of the radicle downward, and of the plume upward, is found, by experiment, to be under the controul of gravitation; hence, we perceive, why plants do not grow perpendicular to the surface, which is frequently much inclined, but always stand perpendicular to the horizon.

CHAP. II.

ANATOMY.

In the living vegetable system there are to be considered the exteriour form and the internal constitution.

Having, in the former part of the work, explained the external characters of plants, we proceed next to an examination of their internal structure.

Observation. The Anatomy and Physiology of vegetables, although a pleasing and important branch of Botanical science, is not absolutely indispensable to the practical botanist, the discriminating characters being taken altogether from external marks. Most of the following observations will be intelligible to every reader, but as the subject is very much connected with the peculiar laws which govern living beings, and with the science of chemistry, the young reader is cautioned not to be dissatisfied with himself, if he should be unable to comprehend them in every particular.

This chapter will be confined principally to a mere description of the several internal parts; the next will be appropriated to the various functions these perform.

The vegetable body consists of the BARK, WOOD, and PITH.

I. *Of the Bark.*

The Bark consists externally of the *Epidermis*, *Cuticle*, or outer bark, next of the *Cellular integument*, and internally of the *Cortex* or inner bark.

1. *Epidermis.* Every part of a living plant is covered with a skin or membrane, called the *epidermis* or *cuticle.*

The term *cuticle* has been applied by anatomists to the scarf skin which covers the animal body. There is the most striking analogy between the animal and vegetable cuticle.

The cuticle is sometimes called the outer bark. Upon the leaves and annual branches it is membranous and transparent. Upon older branches it is more or less opaque, and on the bodies of old trees it is coarse, thick, cleft and scaling off, being sometimes altogether removed, as in old oaks and elms, the dead layers of the *inner bark* performing its functions.

The Birch has its outer bark in circular layers resembling paper, for which that of the White Birch has been used as a substitute.

The outer bark serves the purpose of protection from external injuries, at the same time that it regulates the proportion of absorption and perspiration through its pores. It is destitute of vitality; the only part of a living plant which is dead. Although it does not grow, yet it is capable of very great extension.

The outer bark of many of the grasses, and of several species of *Equisetum* or scouring rush, contains silicious earth or flint. It is so abundant in the Rattan, that it will give fire with steel.

2. *The Cellular integument.* Immediately beneath the cuticle or outer bark we find the cellular integument. This being for the most part green, is the seat of colour, and so far is analogous to the *cutis* or true skin of animals.

The leaf consists of an extension of the cellular integument, covered on both sides by a membranous expansion of the *cuticle.* It is of a succulent vascular nature, and is important in a physiological point of view, being the part in which the fluids are changed by the

action of air and light, and in which the various secretions principally take place.

This part is interposed between the cuticle and the true bark.

3. *Cortex.* Immediately under the cellular integument and next to the wood we find the inner or true bark. It consists of but one layer in plants or branches of only one year old. In older branches or the trunks of trees, it consists of as many layers as they are years old. The innermost layer is called the liber. It is in this layer only that the essential vital functions are carried on for the time being; after which, it is pushed outwards with the cellular integument by the successive formation of new layers, and with the cellular integument finally becomes a lifeless crust.

The inner bark of some species of trees separates when macerated in water into the several layers of which it is composed; each layer, in some cases, appearing perforated like lace. The Lime-tree or Bass-wood is one of the finest examples, in which the fibres are soft and tenacious like hemp, and have been manufactured.

All these layers, in a living state, are closely connected by the cellular texture which pervades the vegetable body generally, as well as by transverse vessels which pass through them. The principal vessels of the bark are the longitudinal ones; they are called *cortical vessels.*

In the bark the peculiar virtues of particular plants chiefly reside, especially in several of its internal layers nearest the wood.

II. *Wood.*

When the bark is removed, we come to the wood, which makes the principal bulk of a trunk of a tree or shrub. When cut across, it is found to consist of a number of concentric layers, called grains, Pl. 3, fig. 17, *c.* very distinct in most trees of our northern cli-

mate. Every year's growth constitutes a layer, so that by counting the several layers the age of the tree may be ascertained.

In a species of ash these layers are very distinct, and are so slightly connected by the cellular substance between them, that by continual beating and bending, the basket-maker is enabled to separate them for his use. These layers are annually secreted or deposited from the innermost part of the bark or *liber*. The wood owes its tenacity and strength to innumerable woody fibres, and consists of various vessels running for the most part longitudinally, Pl. 3, fig. 17, *b*. Some of these vessels have a spiral coat, others not. Some have their sides perforated, and others nearly or quite entire—see pl. 3, fig. 19 & 20. The vessels anastomose or communicate laterally with each other. This is the case also with the vessels of the bark, which are smaller and more complicated than those of the wood.

Observation. In the transverse sections of wood, which are a common and beautiful object in the microscope, these vessels are very conspicuous. In the roots of the Elm, the trunk of the Common Creeper, and the wood of the Chesnut, they are so large that air and even water can be sucked through them in pieces of several feet in length.

Of the vessels of the wood, some in their youngest state convey the sap from the root to the extremities of the branches and leaves, and others contain the various peculiar or secreted juices. The whole are joined together by the cellular substance, which seems to be designed to unite all the parts of a plant.

In some trees, and particularly old ones, there are a number of external layers or grains of wood which differ greatly in colour from the central ones, being much whiter; these are called by the workmen the *sap*, while the central or darker part is called the *heart*. The sapwood is called technically *alburnum*.

The sapwood is the living, vascular, and active part, while the heart is dead or possesses a very low degree

of vitality. The heartwood is usually much more durable timber than the sapwood. In the arrangement of the fibres of the wood there are two distinct appearances. Besides the layers just described, there are a series of white and shining lamellæ, which shoot from the centre towards the circumference, and these constitute what is called the *Silver grain*—Pl. 3, fig. 17, *d*.

The appearance of the silver grain is generally obvious in trees and shrubs, and particularly so in the Oak. Something analogous to it is discoverable in annual herbs.

The silver grain is elastic and susceptible of change of volume by various temperatures.

III. *Medulla or Pith.*

This is situated in the centre of the trunk and branches of plants. In plants of one year's growth it is often very large and full of the juices of the plant; in older ones, it becomes dry, soft, light, and very compressible. In most old trees it is altogether obliterated. It has been thought to be a reservoir of the juices in young plants. The pith is very conspicuous in the Elder, Ash, and Sumach.

General texture of Plants.

Mirbel finds, by the help of the highest magnifying powers, that the vegetable body is a continued mass of tubes and cells; the former extended indefinitely, the latter frequently and regularly interrupted by transverse partitions. These partitions being ranged alternately in the corresponding cells, and each cell increasing somewhat in diameter after its first formation, except where restrained by the transverse partitions, seems to account for their hexagonal figure.* See Pl. 16, fig. 11. *a*. The membranous sides of all these cells and tubes are very thin, more or less transparent,

* In microscopic figures they are generally drawn like circles intersecting each other.

often porous, variously perforated or torn. Of the tubes, some are without any lateral perforations, *b.* at least for a considerable extent; others pierced with holes ranged in a close spiral line, *c.*; in others, several of these holes run together, as it were, into interrupted spiral clefts, *d.*; and in some, those clefts are continued, so that the whole tube, more or less, is cut into a spiral line, *e.*; which, in some young branches and tender leaves, will unrol to a great extent, when they are gently torn asunder. The cellular texture, especially, is extended to every part of the vegetable body, even into the thin skin, called the cuticle, which covers every external part, and into the fine hairs or down, which, in some instances, clothe the cuticle itself.

CHAP. III.

Physiology.

Having, in the former chapter, given a brief outline of the structure of the internal organs of plants, we proceed to give some account of the supposed functions these perform.

I. *Division of a Plant into parts according to the functions they perform.*

Every plant examined as to external structure displays at least four systems of organs. 1. The *Root*; 2. the *Trunk* and *Branches*; 3. the *Leaves*; and 4. the *Fructification.—Davy.*

1. The *Root* fixes the plant in the earth and imbibes the nourishment from the soil. The root is a continuation of the trunk, and is similar to it in its anatomical structure. While the trunk terminates in leaves, the root terminates in fibres or *radicles*, in which its peculiar functions are performed.

2. The *Trunk* elevates the leaves, flower and fruit to a convenient and proper situation, and serves as a me-

dium of vascular communication between the root and these parts.

3. The *Leaves* serve to effect important changes in the juices of the plant, as is presently to be explained.

4. The *Fructification* forms a distinct set of organs for the continuation of plants in succession, one generation after another. For the particular physiology of this part, see *fructification*, p. 45.

II. *The Circulation of the Blood in Animals.*

Physiologists observe an analogy between animals and vegetables, both in anatomical structure and physiological functions, which makes it necessary to explain, especially, the circulation in animals, which is very analogous to what we are about to explain in vegetables.

The blood passes out of the left cavity of the heart* in the main trunk of the arteries, which, dividing and branching like a tree, takes a pretty direct course to all the various parts of the body, where its branches finally become innumerable, pervading every particle of the body, and so small as to elude observation. These are called the *extreme vessels* of the *body*. They gradually collect themselves again into another set of vessels, called the *veins*, which finally unite into two principal trunks that enter the cavity of the right side of the heart together, and convey the blood thither.

By its contractions the heart sends it from the right cavity to the lungs, through a vessel which passes up to them, ramifying, like the artery which has been described, until it pervades every particle of the lungs with its minute vessels, which are called the *extreme blood vessels* of the *lungs*. These finally collect themselves into another set of vessels, which enter the left cavity of the heart in four trunks, and return the blood to be recirculated. The *extreme blood vessels*, in the lungs meet with the extreme branches of the *trachea* or

* The heart has two cavities, a right and left.

Windpipe, which every where accompany them, being separated from them only by very fine membranes.

In these extreme vessels of the lungs the blood undergoes an important change. It gives off a portion of its *carbon* which combines with a portion of the *oxygen* or vital air inspired ; at the same time its capacity for *caloric* or heat is increased, and it drinks up, as it were, the heat of the oxygen, which otherwise would have been developed. By these changes, the blood from a purple, acquires a bright vermillion colour. The blood then passes into the left cavity of the heart, which contracts and throws it through the arteries into the *extreme vessels* of the body, still retaining its vermillion colour.

In the *extreme vessels* of the *body*, the blood performs the important offices for which it was designed in the animal economy. In these, in some unknown manner, its capacity for the matter of heat, is diminished, and the heat which was taken up in the lungs is thus developed, where it is required, in every part of the body. In these vessels also, the body is nourished and its decays built up.

After the blood has passed the extreme vessels, it is found to have lost its fine vermillion, and acquired a dark purple, which it retains as it passes through the veins to the heart, and thence to the lungs, to be renewed and recirculated.

Another system of vessels called the *Lacteals*, take up from the *viscera* the essential nourishment of our food, and convey it by their common trunk, to the circulation emptying it, in form of milk into one of the veins. Thus the great business of the circulation is done in in the *extreme* vessels of the lungs and in those of the body ; the larger trunks serve as mere channels of conveyance, while the heart acts as an engine to give motion. In the extreme vessels of the lungs the blood is *prepared* to nourish and support the body, and in those of the body it *performs* this office.

The arteries in the limbs are deep-seated near the bones, while the veins are much more superficial.

III. *Of the Sap-vessels, course of the Sap, functions of the Leaves, and theory of Vegetation.*

The whole vegetable body is an assemblage of tubes and vessels, as has been previously observed.

Observation. In the arrangement of these there is a degree of similarity in all plants, but each species has its peculiarities just as it has in external characters.

The fluid which is most abundant in these vessels is the sap or blood of the plant, from which are secreted by appropriate organs, all the various vegetable products to which the various flavours and qualities of each plant are owing, as gums, resins, honey, acids, essential oils, &c. These substances must each be lodged in proper cells and vessels to be kept distinct from each other. Air is found to exist in the vegetable body, and must likewise be contained in appropriate vessels.

1. *Of the Sap-vessels and Cortical-vessels, and their communication with each other in the leaf.*

The external surface of the *radicles* or fibres of the roots, are presumed to be perforated by the mouths of innumerable vessels which absorb nourishment.

These absorbents are presently collected into the large simple vessels of the sap-wood, which are compared to the veins of an animal. The sap-vessels, called by Mr. Knight *central* vessels, from their situation near the pith in young plants, pass up and branch off to the leaves and fructification, as they approach them.

Passing through the woody part of the foot-stalks of the leaves, and through the ribs and veins of the leaf, which are its ramifications, they are presumed to terminate in the *parenchyma* or pulp of the leaf, and communicate with the vessels and cells which compose it. Thus they extend from the fibres of the root to the

extremity of each annual shoot of the plant. They have throughout, spiral coats—see plate 3, fig. 18 & 19.

The *cortical vessels* or vessels of the inner bark are very distinct, both in structure and function, from the *sap-vessels ;* they are much smaller, and the spiral coats which are conspicuous in the sap-vessels have never been found in them. Through the medium of the bark of the leaf-stalk these vessels of the inner bark communicate with the cells of the leaf, the same with which the sap-vessels communicate. This is probably the only communication which the two sets of vessels have with each other.

2. *Ascent of the Sap.*

In the following account of the course of the sap, &c. the theory of Mr. Knight is adopted.

In the extreme vessels of the root which immediately absorb the nourishment, an important function is performed. The matter presented to the root is water holding various materials in solution : by an unknown process the extreme vessels of the root, as they absorb this fluid matter of the soil, convert it into sap of the peculiar quality necessary to nourish the plant which absorbs it.

The sap thus formed differs widely in its properties in different species. Sugar, in a greater or less degree, usually abounds in it ; various salts, acids, gums, oils, and resins, are occasionally found in it.

The sap is compared to the blood of animals.

Thus prepared by the root, it undergoes no change of consequence, nor performs any important function until it enters the leaves and fructification. The vessels of the sap-wood, in which it passes, seem destined merely to convey it to the leaves and flowers, elevated in their several convenient situations.

Part of the sap is conveyed into the flowers and fruit, where various fine secretions, such as the volatile

oil, on which depends the aroma or peculiar perfume of flowers, are made from it. By far the greater portion of sap is carried into the leaves, where it is subjected to important changes. In these organs the sap is exposed to the action of light and air, two powerful agents by which it is enabled to form various secretions, which give peculiar flavours and qualities to the leaves themselves, at the same time that much superfluous matter passes off by perspiration.

The sap, thus modified in the leaves, is returned by another set of vessels into the new layer of bark.

More will be said of the descent of the sap and growth of the plant after we have given an account of

8. *The Structure and Functions of the Leaves.*

The Leaves are very aptly compared to the lungs of animals. They are the organs of *respiration, perspiration,* and *absorption.*

The alburnum or sap-wood is continued into the leaf-stalk, which branches out into the leaf, forming what is called the skeleton of the leaf, which is frequently seen after the worms have devoured the other parts. The spiral tubes attend the alburnum throughout this skeleton; they are conspicuous in the leaf of the Rose, Lilac, Lilies, and particularly so in the Common Eel-grass; when these are torn and gently separated, they are seen unrolling themselves from the broken ends of the nerves and veins.

This skeleton is clothed on both sides by a membranous extension of the cuticle; between these two membanes is the fleshy substance of the leaf called *parenchyma,* which consists of vessels and cells filled with the juices of the plant.

The upper surface, which is exposed to the sun, is darker than the under, its epidermis is thicker but transparent, allowing a free passage of light.

On the under surface, the epidermis is thin and full of cavities, and, it is probable, altogether by this sur-

face that leaves perspire, and absorb the principles of the atmosphere necessary for vegetation. The under surface is so constructed that water will not wet it, but collects in large drops and rolls off, otherwise its functions might be obstructed.

There are in the leaves of some plants, either on one or both surfaces, a large number of small whitish points, scarcely apparent to the naked eye but easily distinguished with a glass. They are found to consist of small fissures surrounded by areas. These pores, which contain air only, are surrounded by a pair of cells, which contain a greenish fluid in common with the other cells of the leaf. Through these pores and cells the communication appears to be kept up between the external air and the juices of the leaf.—See Smith's Bot. Note 84, by Prof. Bigelow.

The upper side of leaves is uniformly turned to the light. If a branch be overturned, the foot-stalk will twist until the leaf regains its former position.

Light is so essential to vegetation that few plants can be perfect without it. Plants growing in the shade, besides other imperfections, are without colour. When they are placed in a room where the light comes only laterally from a single window, they incline not only the leaves, but the whole plant takes a course towards it.

Three kinds of vessels centre in the lungs of animals, the *Arteries*, the *Veins*, and the *Air-vessels* of the *Wind-pipe*. In the leaves, the *Sap-vessels*, the *Cortical-vessels*, and *Pores*, which convey air, communicate with each other.

In the lungs of animals the purple blood from the veins absorbs oxygen gas from the air inhaled through the air-vessels of the Wind-pipe, which combines with a portion of the carbon of the blood, and is thrown off at the next breath in the form of carbonic acid gas, while the caloric of the oxygen is absorbed, to be carried on in the arteries and disengaged in the extreme vessels. Watery vapour is also given off by the lungs.

The leaves, in the sunshine, uniformly absorb carbonic acid gas from the atmosphere, by their under surfaces, and decomposing it, retain the carbon and give out its oxygen. The carbon retained, no doubt goes into the juices in the leaves. This, it will be perceived, is the converse of what is effected on the atmosphere by the lungs of animals. Animals absorb *oxygen* and produce *carbonic acid gas*, but vegetables absorb *carbonic acid*, and give out *oxygen gas*; thus animals and vegetables serve, very happily, to counteract each other's effects on the atmosphere.

In animals, the blood in the lungs, by parting with some of its carbon, changes from a purple to a vermillion colour. In the leaves, the juices from being colourless, become green, not by losing carbon, for that principle is increased in them.

So great is the quantity of carbonic acid gas produced by the breathing of animals, and various chemical operations in nature, that we should probably be suffocated by it were it not continually decomposed by the whole world of vegetables, and the pure vital air restored for our respiration.

Leaves in the night give out carbonic acid, but in a less quantity than that which they absorb during the day. Flowers are found to give out carbonic acid both in the sunshine and shade, of course their effect is uniformly to vitiate the air.

Observation. 1. It will be perceived, from what takes place in leaves, that plants derive a part of their solid nourishment from the air, that is, the carbon or charcoal matter from the decomposed fixed air or carbonic acid gas.

2. Some inquiries of Mr. Ellis of Edinburgh go to prove, that vegetating plants, at all times, absorb oxygen and produce carbonic acid in its stead.—*Smith's Bot.* p. 175. *Note.*

The leaves are also organs of perspiration. The blood or juices of plants give off a portion of their water in the form of perspiration, through the under surface of the leaves. Dr. Hales proved that an annual Sunflower perspired in dry weather, more than a man. The Cor-

nelian Cherry perspires, in the course of 24 hours, several times its own weight. In moist weather, however, plants sometimes absorb moisture by their leaves.

The rapid waste of moisture, by the perspiration of the leaves, and its supply by the absorption of the roots, are both indicated by the rapidity with which a plant wilts when plucked from its root, and its immediate revival when the stem is placed in water. It is indicated also by the very great quantity of water necessary to supply some plants when placed in the house in an espalier or flower-pot.

4. *Descent of the Sap and Growth of the Plant.*

It is very contradictory to the common notions of vegetation, that plants should grow by a flow of sap from the leaves downward; yet this point seems to be well established by Mr. Knight's experiments.

The sap, having ascended from the roots to the leaves, and being there modified and prepared, as has just been described, descends through the vessels of the bark, for the double purpose of nourishing and increasing the plant, and of producing the various secretions, such as gums, resins, turpentines, oils, &c. which are usually found in the bark. "In the bark, principally, if I mistake not, these peculiar secretions of a plant are perfected, each, undoubtedly, in an appropriate set of vessels."—*Smith.*

The new layers of bark and wood appear to be added in trees in the following manner.

The descending cortical vessels of the liber, in the growing season, throw out between the bark and the wood, a pulpy or gelatinous matter, which has been called *cambium.* The cambium, as it gradually becomes fibrous and of a firmer consistence, separates into a new layer of bark, which attaches itself to the other layers, and, in its turn, secretes another cambium; and a new layer of wood, which is deposited upon the outside of the former layers.

Observation. 1. When the cambium first begins to be fibrous, although produced by the bark, yet it adheres so much more firmly to the wood, that it remains quite entire upon it when the bark is removed. It contains much saccharine matter, and in those trees, in which it is not tinctured with any disagreeable property of the plant, as bitterness, it is palatable.

It is particularly so in the Birch. Children, in the country, sometimes seek for it, and appear to be as fond of it as they are of fruit.

2. At the season when the *cambium* is perfectly formed, trees may be stripped of their bark entirely without injury, a new bark being speedily formed upon them. This has been thought to prove, that the wood had power to produce a new bark. I have several times made the experiment on forest trees with perfect success, and from some circumstances attending it, am inclined to the following opinion. That the cambium, containing the rudiment of a new layer of bark, as well as of a new layer of wood, is not removed with the bark, but remains undisturbed on the trunk, and thus the new bark, which forms in this case, is not formed by the wood, but had its rudiment previously formed by the bark. This method of removing the old bark has been turned to advantage in fruit trees, whose bark had become bound. Care should be taken not to injure the pulp of the cambium. It should be protected from the weather a while by some soft covering.

In animals, the trunks of the arteries serve as mere channels to convey the blood into the extreme vessels, which are distributed throughout every fibre of the body. It is in these extreme vessels, that the great vital functions go on; in these it is, that parts are increased or renewed, and in these animal heat is produced. The veins collect the blood, after it has performed these functions, and return it through the medium of the heart, to the lungs, to be renewed by the air, and sent round again by the arteries.

In the vegetable, the sap-vessels are analogous to the veins, and the vessels of the leaf to the extreme vessels of the lungs. The vessels of the bark, are compared to the arteries. There are not any vessels in vegetables, which carry the descending sap back again from the bark to the vessels of the sap-wood to be recirculated. The sap is supposed to be exhausted altogether, by nourishing the plant in its descent.

In this respect the course of the sap in vegetables differs essentially from the circulation in animals.

5. *Growth in general.*

The growth of the trunks and branches, as it respects thickness, takes place by means of successive layers, which are annually added, one to the bark, and another to the wood, in a manner already described.

The elongation of trunks and branches of trees and shrubs takes place by annual shoots, which are made at their extremities. No part already formed is carried upward or enlarged in proportion in all its parts, as is the case with animals.

The Sword-leaved plants, such as Iris and some species of Lily, elongate by additions to their base, while the parts perfectly formed are carried upward; hence they appear of a darker green at their extremities than near the ground. Most of the grasses elongate by additions to the bases of their several joints.

Observation. I have determined these points by placing stakes beside the growing plants and marking them.

That part of a plant which is the shooting part, whether it be the base or extremity, is usually whitish and tender.

6. *Duration of the Vascular Systems.*

All perennial plants have annually a new set of radicles to their roots, a new growth of leaves to their branches, whether the former ones have fallen or not, a new layer of bark, and a new one of wood added to their bodies. Dr. Smith says, "the vascular system of all plants is strictly annual. This of course is admitted in annual plants, the existence of whose stems, and often of the whole individual, is limited to one season; but it is no less true with regard to trees. The layer of *alburnum*, on the one hand, is added to

the wood, and the *liber*, or inner layer of bark, is on the other, annexed to the layers formed in the preceding seasons; and neither have any share in the process of vegetation for the year ensuing. Still, as they continue for a long time to be living bodies, and help to perfect, if not to form, secretions, they must receive some portion of nourishment from those more active parts, which have taken up their late functions."

The vital functions of these systems diminish with their age. Thus, on one hand, the layers of bark, with their systems of vessels, are pushed outward by the new layers within, gradually diminishing in vitality, until they finally become quite dead, split and scale off, as we see them in old trees. On the other hand, the layers of wood are successively covered by the new layers of *alburnum*, gradually losing their vital powers, until at last they become quite destitute of vitality, and then constitute the *heart-wood*. The *heart-wood* sometimes goes a step farther, decomposes and leaves the tree hollow.

7. *Facts which tend to prove the preceding theory of vegetation.*

1. The old physiologists had an idea, that the vessels of the alburnum contained nothing but air. Dr. Darwin and Mr. Knight, by placing the cut ends of the twigs of various plants in coloured fluids, succeeded in making these vessels absorb them in such a degree, that they were enabled to trace them in the vessels quite into the leaves; thus proving that they carried fluids.

2. When a tree is wounded, it heals from the upper edge of the wound downward, while below the wound, the tree dies in a sort of triangular space, until by the anastomosis or lateral communication of the vessels of the bark with each other, the parts are supplied with what is necessary to their vitality.

3. It has been stated that grapes came to maturity much earlier, were larger, and better flavoured when a small circle of bark, one or two eighths of an inch wide, was removed from around the alburnum of the fruitful branches, while the fruit was in its young state. Dr. Bigelow mentions that this method is annually practised in the vicinity of Boston, by different individuals, with the best success.—See Smith's Botany, page 59. According to Mr. Knight's theory, the explanation is obvious. The sap continues to ascend with freedom, but being interrupted in its descent, and confined to the branches above the incision, a geater quantity of it goes to nourish the fruit.

4. Du Hamel, by many experiments, proved the wood to be deposited from the innermost part of the bark or *liber*. He introduced plates of tinfoil under the bark of growing trees, and after some years, on cutting them across, he found the layers of new wood, equal to the number of years, on the outside of the tin.

Observation. Linnæus had a peculiar notion that the new layers were secreted annually from the pith, and added internally to the former ones.

5. It has been mentioned, that at a particular season, trees may be stripped of their bark without injury, a new bark being speedily formed. This was thought to go against the theory, but if it be true, as I have suggested, page 116, that the rudiment of the new bark is formed before the old bark is removed, and is not removed with it, but remains on the wood, it accords perfectly with it.

8. *Of the power which elevates the Sap.*

The manner in which the sap is propelled through the several tubes, and elevated to the top of the tallest tree, seems not to be well understood.

Whatever may be the action which propels the fluids, it must possess great power, for the mass of fluid in a large tree, which is not only supported by it, but mov-

ed upward with considerable force, amounts to several tons.

In animals, the blood is propelled around its curcuit by the powerful muscular contractions of the heart and arteries. It is also solicited by the action of the extreme vessels. Mr. Knight supposes that the silver grain, being susceptible of quick contraction and expansion by heat and cold, has an agency in propelling the sap by pressing upon the vessels.

It has been supposed that the propulsion of the fluids in vegetables takes place in a manner similar to that of animals, i. e. that they are in some way acted on by the coats of the large vessels, and that they are likewise drawn up by the action of the extreme vessels of the leaf. The spiral coats of the vessels have been suspected of having an agency in this business. "In some of these, when separated from the plant, Malpighi tells us, he once saw a very beautiful undulating motion that appeared spontaneous. This indeed has not been seen by any other person, nor can it be supposed, that parts so delicate can, in general, be removed from their natural situation, without the destruction of that fine irratibility, on which such a motion must depend."—*Smith.*

Observation. I was once examining some Eel-grass, in which these spirals are numerous and may be drawn out to a great length; but my object at this time was not to observe them. The grass was moist from the salt water and laid in a heap, variously broken and torn asunder, on a table in a dry, warm room. I was presently surprised by the appearance of numbers of white filaments in a very brisk vermicular motion, and which I actually took for little worms. They seemed to raise themselves frequently in end, and being bent at various angles, turned rapidly round in one direction a while, then changed and turned in the opposte, making at the same time various other animated movements. Putting them in the microscope, I found they consisted of the spiral coats, which, from the manner in which they had been drawn out, were twisted, and when drawn quite asunder had, consequently, twisted together into an elegant little cord, which being very susceptible of changes of volume by alternate dryness and moisture, had been put in motion by the fluctuating vapour arising from the moist grass.

I made some experiments to see how they would be affected by changes of temperature, but determined nothing further than their mechanical sensibility to water, being a most extraordinarily delicate Hygrometer, actively affected even by the vapour of the hand at a considerable distance.

It might have been something like this which Malpighi observed.

Although this may not throw any immediate light on the interesting subject of the propulsion of the sap, yet the fact will doubtless be thought worth noticing.

It is most probable that the propulsion of the sap is not to be explained on any *mechanical* principles, but is in some way the effect of *vitality*.

IV. *Sleep of Plants.*

Many leaves, especially the pinnate ones, of leguminous plants, fold themselves together at night or droop as if dying. It is a fact, very commonly observed, that many flowers close at night without opening again until the next day. Some flowers are open only in the morning, closing before noon. Common names are sometimes applied from the hour of their closing or expanding; as *Four o'clock*. The compound flowers are very much disposed to close during the night. The Dandelion and Marigold are examples.

Shakspeare notices this fact in the Marigold in the following lines.

> Her eyes like marigolds had sheathed their light,
> And canopied in darkness lay
> Till they might open to adorn the day.

This change of the leaves and closing of the flowers are what is called the sleep of plants. It seems to take place in consequence of the absence of light.

Light acts beneficially on the upper surface of leaves and hurtfully on the under side; hence the upper surface is always turned to the light in whatever situation the plant may happen to be placed.

The leaves of a great number of plants follow the sun in his daily course. Clover is an example.

Many flowers also follow the sun, as the Sunflower

and other compound radiate ones. "In their forms Nature seems to have delighted to imitate the radiant luminary to which they are apparently dedicated, and in the abscence of whose beams, many of them do not expand their blossoms at all."

It has already been mentioned, that the functions of the leaves, in decomposing carbonic acid and delivering out its oxygen, were performed only in the sunshine. The most important functions of flowers are also performed in the sunshine only. Most plants vegetate but imperfectly in the shade, and scarcely at all in perfect darkness. Trees, which are overgrown by others around them, decline and finally die.

Leaves and flowers are attracted by light, and probably have their vital functions stimulated by it.

The pinnate leaves of the Sensitive-plant, *Mimosa sensitiva*, and some other plants, have a most extraordinary sensibility not only to light but to the touch of any extraneous body or to any sudden concussion. By even a gentle impression to one of the leflets they will close together, one pair after another, and finally the whole leaf will drop down to the stalk.

> "Weak with nice sense the chaste Mimosa stands,
> From each rude touch withdraws her timid hands;
> Oft as light clouds o'erpass the summer glade,
> Alarmed, she trembles at the moving shade,
> And feels alive through all her tender form
> The whispered murmurs of the gathered storm;
> Shuts her sweet eyelids to approaching night,
> And hails with freshened charms the rising light."

Hedysarum gyraus has a spontaneous motion in its leaves, independent of any external stimulus, even of light, and only requiring a very warm atmosphere to be performed in perfection. That it does not depend on any motion of the atmosphere is proved by its continuing under a glass bell.

These various phenomena depend no doubt on what is termed *vital irritability*, which means a power in living beings independent of any thing mechanical, by which they act when certain agents are applied.

It remains to make some observations on

Instruments for botanizing and the method of preparing an Herbarium.

Instruments.

1. A small knife, a pair of scissors, a bodkin, a pair of forceps, and a glass or microscope for dissecting and examining plants.

A bodkin may be made by fitting a piece of wood into the sliding socket of a pencil case and inserting a needle into it.

The forceps should be a simple spring; a strip of brass or other metal bent over at a short angle like a V, about 2 inches long, points $\frac{1}{4}$ inch apart, to close by pressure with the fingers like sugar-tongs. These will be found very convenient.

These several instruments should be in a pocket case.

A simple glass of from one to two inch focus, such as the watch-makers use, or a penknife with a glass in the handle, as may now be obtained in the shops, will answer very well.

Pocket microscopes with a reflector to illuminate the object, and adjusting forceps, are now manufactured and sold by J. Peirce, optician, Marlborough street, Boston, which are very useful, especially in examining the grasses and mosses, besides being convenient for examining any other small interesting object.

2. A tin box to receive those specimens, when collected, which are afterward to be examined. A close box of this kind immediately becomes full of the vapour of the plants. Further evaporation being thus prevented, the plants are preserved fresh for days, especially if a few drops of water be put in with them. It may be made of a flattened form so as to be carried in the pocket.

3. A portfolio, furnished with strings, containing a parcel of paper like a large, thin book, to collect those specimens which are to be dried and preserved.

HERBARIUM.

A collection of dried specimens of plants is called an *Herbarium* or *Hortus siccus*.

Upon the subject of collecting and preparing specimens I refer the reader to Smith's botany and to Richard's Dictionary, New-Haven translation, giving at the same time the outlines of a method which I have found very successful in practice.

The most usual method of preparing specimens, is to dry them between papers under pressure, which is the method I am to give some account of.

When a specimen is taken it should be put into the portfolio or into a book immediately, before it wilts to alter its habit. Very little care should be taken in placing the various parts, except that some of the flowers may be laid open so as to display the parts which compose them. If the plant be small, the root and all the other parts should be taken. If it be tall like the grasses, it should be cut into pieces and brought upon the paper, or partially broken in several places and folded down once or more in a zigzag manner, passing the last fold obliquely across the others, and tying it to them with silk or thread where it crosses them, that it may keep in place when handled.

Every thing belonging to the natural habit of the plant should be preserved; the dead leaves should be suffered to remain, and even a little of the native rubbish upon the roots often indicates the peculiar situation in which the plant grows.

The specimens are next to be dried under pressure, which may be applied by laying a board upon the papers containing them, and putting weights upon it, or by placing them between two shelves and setting a prop down upon them, or by a press made for the purpose. There should be paper enough to accommodate itself to the inequalities of the specimens, and by pressing upon them uniformly and equally in every part to pre-

vent them from shrivelling, which is the very object of pressing them. The degree of pressure should be according to the nature of the specimens, more being necessary for rugged woody ones than for delicate herbaceous ones; it should never be so great as to break the specimen and force out the juices. I commonly apply from 50 to 1 or 2 hundred pounds.

When a number of specimens are to be dried at once, several folds of empty paper should be interposed between them, and if they are rigid, a piece of bookbinder's pasteboard also. The specimens should be frequently taken out and put into dry papers.

The following is the most expeditious and effectual method of drying the papers I have tried.

Take a few spare sheets, and having laid the tongs or other convenient instrument from one andiron to the other of a kitchen fire, set them up against it. When the one next the fire is sufficiently dry and warm, remove it and place a specimen in it, applying the damp paper from which the specimen has been taken, to the backside of the parcel before the fire, and so on, taking a dry paper from the foreside of the parcel and applying a moist one to the backside, until all the specimens are changed, when they are to be replaced in the press

Another method equally effectual and more comfortable in warm weather, though not so expeditious, is to iron the papers dry with a hot flat-iron, instead of placing them before the fire, and then place the specimens in them as before.

This should be repeated as often as once or twice in a day, or oftener if the weather be damp, or the specimens crowded. The best specimens I ever prepared were done by changing and drying the papers once every half hour until they were dry. I commonly use printing paper, which having little size, is more absorbent than other kinds.

Plants which are not very rigid, can be dried very well in a book without changing, if only two or three are put into a volume. Plants dry very variously; some unavoidably turn black by drying, as the *Orchis* and *Cypripedium*. Flowers in many instances lose or change their colour; those that are blue especially.

After a specimen is dry, it should first be done over with a solution of corrosive sublimate in spirits of wine, one drachm to a pint, with a little camphor; or a solution of aloes, applied by means of a camel's hair pencil. This proves effectual in preventing the attacks of insects. It is next to be fastened to paper, which is best done by means of carpenter's glue. I first used a solution of gum Arabic, but specimens fastened with it are very apt to get detached in a short time, especially if handled. Glue is much superior. As it will not keep in a dissolved state any length of time, it must be dissolved at the time of using, and made into a thin size, which may be done by boiling a small piece in water in any convenient small vessel. A few drops of the solution of corrosive sublimate should be added. The specimen should be held out in one hand, and the size applied while warm uniformly over one side of it, with the other, by means of a large camel's hair pencil. It is then to be put immediately on the paper. Take care to place it right the first time, otherwise the size will deface the paper where is is not required; a piece of waste paper should be laid over the specimen and another under the paper. In this state put it immediately in the press between two or more quires of empty paper to form a bed for it, and screw the press firmly upon it. Let it remain one or two minutes, and taking it out remove the waste papers and apply new ones; repeat this as often as they are soiled by the size, otherwise the papers will be glued together.

The paper is usually directed to be of the folio size, (the full size of a quire.) I have commonly used what

is called demy printing paper, folded quarto size, (half the size of the quire.) I fasten my specimens to the right hand side of a folded sheet, leaving the other to fold over it. On the outside of the left hand side I write the names of the Class, Order, Genus, and Species of the plant; and upon the inside of the same, its name, synonyms, common names, place of growth, time of gathering, and any thing else I wish to remember concerning it.

Great neatness should be observed in an herbarium. The papers should all be of the same size, and kept regularly and evenly packed. I have usually kept mine in several parcels, each between two pieces of bookbinder's pasteboard, tied down with tapes.

The uses of prepared specimens are,

1. *To get a knowledge of Plants.* When a number of plants are well prepared, we have an opportunity to compare them with each other all at once, and see in what they agree, and in what differ.

Observation. When a botanist has taken and examined a specimen, dried and prepared it on paper, as has been directed, and written its name upon it, he will have done about enough, and probably none too much to remember it well. It is well for every one, who wishes to be in any degree a practical botanist, to prepare a few specimens, if it be only fifty or an hundred species. Independent of the value of the collection, he will thus acquire a particular knowledge of the plants.

2. *To revive in the memory the names and habits of plants which have been previously examined.*

3. *To find out unknown plants which cannot be otherwise determined, by sending the specimens to some one acquainted with them.* For this purpose duplicates should be prepared and numbered with corresponding numbers, one set being retained when the other is sent for examination.

QUESTIONS FOR STUDENTS.

A few general questions are here put down. It is left for the instructer to construct particular questions extemporaneously, from the subject of the lesson before him; varying them according to the knowledge and capacity of the pupil. For in this as well as other casses an instructer will find it necessary to seek out what avenues are open to the young mind, and shape his precepts accordingly.

1. What is Natural History? p. 1.
2. Into how many branches is Natural History divided, and what are they called? p. 1.
3. Of what does Zoology treat? p. 1.
4. Of what does Botany treat? p. 1.
5. Of what does Mineralogy treat? p. 1.
6. What is meant by Characters? p. 3.
7. Give an example of a *simple character* of a plant? p. 3.
8. What is system? p. 3.
9. What are the advantages of system? p. 3.
10. How is the vegetable kingdom divided, according to the Linnæan system? p. 4.
11. What divisions are the Classes? p. 4.
12. What are the Orders? p. 4.
13. What are Genera? p. 4.
14. Give an example of a Genus? p. 4.
15. How is a Genus known? p. 4.
16. By what mark is the family of Buttercups known? p. 4.
17. What are Species? p. 4.
18. Give an example of the Species of a genus? p. 4 & 5.
19. What are Varieties, and how are they distinguished from species? p. 5.

20. Give an example of Varieties. p. 5.

21. To what are Classes, Orders, Genera, and Species compared? p. 5.

22. What are Vegetables? p. 5.

23. What are the Primary divisions into which Botanists divide a plant or vegetable? p. 5.

24. Define the Root. p 6.

25. Of what part does the root consist? p. 6.

26. Which of these is most necessary? p. 6.

27. Of what does the Herbage consist? p. 10.

29. How many kinds of Trunks are enumerated? p. 10.

30. Name each of the 7 kinds and define it so as to see how they differ from each other. p. 10, 15, 16, 18, 19, 20.

31. What do Buds contain? p. 20.

32. What is intended by Foliation? p. 20.

33. Define a Leaf. p. 22.

34. What is a simple leaf? p. 26.

35. What are compound leaves? p. 35.

36. How is a compound leaf distinguished from a branch? p. 35.

37. What is meant by Inflorescence? p. 40.

38. Define the Appendages of plants, as Stipule, Bract, Spine, Prickle, Tendril, Gland, Hair, and mention examples. p. 38.

39. Define the various kinds of Inflorescence, as Whorl, Raceme, Spike, Corymb, Fascicle, Umbel, Cyme, Panicle, Thyrse, and mention examples. p. 40.

40. Of what does the Fructification consist? p. 45.

41. What is the use of the fructification? p. 45.

42. Does every species of plants produce flower and fruit? p. 45.

43 Define the seven parts of fructification, Calyx, Corolla, Stamen, Pistil, Pericarp, Seed, and Receptacle. p. 45.

44. Which of these parts are essential and always present? p. 43.

45. Name and define the several kinds of Calyx. p. 46.

46. Name and define the several kinds of Corolla. p. 49.

47. What is the Nectary? p. 53.

48. Of how many parts does a Stamen consist? p. 54.

49. Which of these is essential and always present, and which sometimes wanting? p. 54.

50. What is the Pollen? p. 54.

51. What causes the Anther to burst? p. 55.

52. What are the grains of Pollen? p. 55.

53. What causes the grains of Pollen to burst? p. 55.

54. Of what parts does a Pistil consist? p. 55.

55. Which of these is absent in some flowers? p. 55.

56. What are the functions of the stamens and pistils? p. 56.

57. From the office the stamens and pistils perform, is it necessary they should be present in every species of plant? 56.

58. When a flower has stamens only, what is it called? p. 57.

59. When a flower has pistils only, what is it called? p. 57.

60. When a flower has stamens and pistils both, what is it called? p. 57.

61. What part of the flower forms the seed-vessel or Pericarp? p. 57.

62. What are the various kinds of pericarps? p. 57.

63. What part of the fructification are all the other parts designed to perfect? p. 59.

64. What is the Receptacle? p. 62.

65. When is the receptacle called proper and when common? p. 62.

66. What is an aggregate flower? p. 62.

67. Define the several kinds of aggregate flowers p. 62.

68. What is the use of dividing and subdividing the vegetable kingdom into Classes and Orders? p. 64.

69. Why are the Classes and Orders called *Artificial divisions?* p. 64.

70. Name the Classes and give the character by which each is known. p. 65.

71. Name the Orders and give the characters by which they are distinguished. p. 68.

72. Define a Genus. p. 79.

73. What is meant by the *Generic character* ? p. 80.

74. What are species ? p. 83.

75. What is meant by the *Specific character ?* p. 84.

76. From what parts of the plant are the characters of the Classes taken ? p. 85.

77. From what parts are the characters of the Orders taken ? p. 85.

78. From what parts are the characters of the Genera taken ? p. 85.

79. From what parts are the characters of Species taken ? p. 85.

80. How do you proceed to find out an unknown plant ? p. 86.

EXPLANATION OF THE PLATES.

PLATE 1.

ROOTS.

Fig. 1. A FIBROUS ROOT. Ex. Grass. p. 7.
2. CREEPING. Ex. Mint.
3. FUSIFORM or SPINDLE-SHAPED. Ex. Radish.
4. ABRUPT.

Tuberous Roots.

5. TUBEROUS. Ex. Potatoe.
6. Twin tuberous root. Ex. *Orchis.*
7. Palmate tuberous root.
8. Fasciculate tuberous root.

Bulbous Roots.—p. 8.

9. Solid bulbous root. Ex. Tulip.
10. Coated bulbous root. Ex. Onion.
11. Scaly bulbous root. Ex. Lily.
12. GRANULATED. p. 9.
13. JOINTED.

PLATE 2.

TRUNKS.

Fig. 1. A STEM (*caulis.*) p. 10.
2. Four-ranked stem. p. 11.
3. Dichotomous or forked stem. p. 11.
4. Creeping stem.
5. Twining stem. Ex. *Convolvolus.* p. 12.
6. CULM (*culmus.*) Ex. Grass. p. 15.
7. SCAPE. Ex. Dandelion.

a. The scape.
b. A naked receptacle.
c. The pappus.
d. A flower.

8. FROND. Ex. *Polypodium vulgaris.* p. 19.
8 *a.* STIPE. p. 20.
9 *a.* A stipe also. Ex. *Fungus.*
b. The Volve, *c.* the Head of the fungus.

PLATE 3.

FOLIATION.—p. 23.

These figures represent sections of buds.

Fig. 1. A convolute bud.
2. Involute.
3. Revolute.
4. Conduplicate.
5. Obvolute.
6. Equitant.
7. Plicate.
8. Imbricate.
9. Circinal.

FRUCTIFICATION OF THE FERNS.—p. 73.

10. A Fern leaf having its fruit covered with involucres. *a.* One of the involucres or patches magnified.
11. A capsule of the same. *a.* Its ring. *b.* The hemispherical valves.

FRUCTIFICATION OF THE MOSSES.—73.

12. A Moss. *a.* The Perichætium, as in the genus *Hypnum*. *b.* The Peduncle. *c.* The Fruit.
13. A capsule of a species of *Hypnum* magnified.
14. The same with the Calyptra *b.* separated.
15. The same with the Lid (*operculum*) *b.* separated, exposing the fringe, *a.*
16. The same with the exteriour row of the fringe *a.* expanded, the interiour with the points gathered in the centre.

ANATOMY OF THE VEGETABLE BODY.—p. 102.

17. A section of the branch of an Ash magnified. *a,* The bark. *f,* The wood. *b,* The sap-vessels. *c,* The concentric layers. *d,* The silver grain. *e,* The pith.
18. The section of its natural size.
19. A tube or sap-vessel with its coat variously perforated and slitted in a spiral manner.
20. A simple spiral tube.

PLATE 4.

LEAVES.

Situation and position of Leaves.—p. 22.

Fig. 1. Alternate leaves. p. 23.
2. Scattered.
3. Opposite.
4. Clustered.
5. Verticillate or Whorled.
6. Fasciculate.
7. Imbricate.
8. Decussate.
9. Two-ranked.
10. Unilateral.

Insertion.—p. 24.

11. Peltate. p. 24.
12. Amplexicaul or Clasping. p. 25.
13. Connate.
14. Perfoliate.
15. Vaginant.
16. Equitant.
17. Decurrent.
18. Flower-bearing.

PLATE 5.

LEAVES CONTINUED.

Form of Simple Leaves.—p. 26.

Fig. 1. Orbicular or circular. p. 26.
2. Subrotund or roundish.
3. Ovate.
4. Obovate.
5. Elliptical.
6. Spatulate. p. 27.
7. Lanceolate.
8. Wedge-shaped
9. Linear.
10. Acerose or needle-shaped.
11. Triangular.
12. Quadrangular, and Truncate also.
13. Quinquangular.
14. Deltoid, or trowel-shaped.
15. Rhomboid.
16. Reniform, or kidney-shaped.
17. Cordate, or heart-shaped.
18. Lunate, or crescent-shaped. p. 28.
19. Saggittate, or arrow-shaped.
20. Hastate, or halbert-shaped.
21. Panduriform, or fiddle-shaped.
22. Runcinate, or lion-toothed.
23. Lyrate, or lyre-shaped.
24. Cleft or cloven.
25. Lobed.

PLATE 6.

LEAVES CONTINUED.

Fig. 1. A Sinuated leaf.—p. 28.
2. Parted.
3. Laciniated. p. 29.
4. Palmate, or hand-shaped.
5. Pinnatifid.
6. Bipinnatifid.
7. Pectinate.
8. Unequal.

Termination.—p. 29.

9. Premorse. p. 30.
10. Retuse.
11. Emarginate.
12. Acuminate.
13. Blunt, with a small point.
14. Mucronate.
15. Cirrhose, or tendrilled.

Margins.—p. 30.

16. Spinous.
17. Ciliate, or fringed.
18. Dentate, or toothed. p. 31.
19. Serrate.
20. Crenate.

PLATE 7.

LEAVES CONTINUED.

Fig. 1. Jagged.—p. 31.
2. Repand, wavy-bordered.

Surface.

3. Plaited. p. 32.
4. Undulate.
5. Curled.
6. Veiny.
7. Nerved.
8. Three-nerved.
9. Base-three-nerved. p. 33.
10. Triply-nerved.

Substance, Configuration, &c.—p. 33.

11. Cylindrical.
12. Subulate, or awl-shaped,
13. Hatchet-shaped.
14. Scimitar-shaped.
15. Three-edged.
16. Four-edged.
17. Alienated.

PLATE 8.

LEAVES CONTINUED.

Fig. 1. Hooded. p. 35.
2. Appendaged.

Compound Leaves.

3. Jointed.
4. Digitate, or fingered, and Quinate also.
5. Binate.
6. Ternate. p. 36.
7. Pinnate, with an odd leaflet. It is also a compound leaf, simply—see p. 37.

a. A Stipule.

8. Pinnate, with a tendril.

a. A Stipule.

9. Pinnate, abruptly.
10. " alternately.
11. " interruptedly.
12. " in a lyrate manner.
13. " in a whorled manner.

PLATE 9.

LEAVES CONTINUED.

Fig. 1. Twice ternate. p. 37.
2. Triternate.
3. Bigeminate, twice paired.
4. Bipinnate, and Decompound also.
5. Tripinnate, and Superdecompound also.
6. Pedate.

APPENDAGES.

7. A Bract. p. 38.

PLATE 10.

APPENDAGES CONTINUED.—p. 38.

Fig. 1. Spine, or thorn. p. 39.
2. A Prickle.
3. Glands on the leaf-stalk of the Passion-flower.
4. Glands on the calyx of the Moss Rose.
5. The Nettle. *a.* One of the stings (*stimuli*) magnified. It is a tube opening at the point and containing a sack of poison at the base, which when pressed on is discharged through the point and produces the inflammation and itching in the skin.
6. A hairy leaf.

INFLORESCENCE.—p. 40.

7. A Whorl. p. 40.
8. Raceme.
9. Spike. p. 41.

PLATE 11.

INFLORESCENCE CONTINUED.

Fig. 1. A Corymb. p. 41.
2. Fascicle. p. 42.
3. Umbel.
a. The universal or general umbel and involucre.
b. The partial umbel and involucre.
4. Cyme. p. 43.
5. Panicle.
6. Thyrse.

PLATE 12.

FRUCTIFICATION.

Parts of a Flower.—p. 45.

Fig. 1. White Lily, *Lilium candidum.*

a. a. a. The COROLLA consisting of 6 petals.
b. The STAMENS.
c The PISTIL.
d. The NECTARY, which is a groove in the petal.

2. A dissection, showing the stamens and pistil, and likewise the RECEPTACLE, *a.*

3. A STAMEN, consisting of

b. The Filament, and
a. The Anther. p. 54.

4. The PISTIL, consisting of

c. The Germen,
b. The Style, and
a. The Stigma.—p. 55.

PLATE 13.

CALYX.

Fig. 1. Perianth. Ex. Pink. p. 46.

2 & 3. Ament. Ex. Willow. p. 48.

2. The barren flower. *b*. A floret magnified consisting of 2 stamens and a scale which protects them.

3. The fertile flower. *a*. A magnified floret, consisting of a pistil and a scale which protects it.

4. Ament of the Hazel. *a*. The barren, and *b*. The fertile flowers.

5. Spathe. Ex. Wild Turnip, *Arum*. p. 48.

a. A stamen-bearing, and *b*. A pistil-bearing spadix.

6. *a*. The spathe of the *Narcissus*.

b. Its Nectary.

7. The Glume.

a. The valves.

b. The awns. p. 49.

8. *b*. The Calyptra. Ex. *Polytricum*. p. 49.

COROLLA.

9. Bell-shaped. p. 51.

10. Funnel-shaped, p. 51.

a. The tube.

b. The limb.

11. Salver-shaped. p. 51.

12. Wheel-shaped. p. 51.

13. Ringent, showing the stamens separated. p. 51.

a. The upper lip or helmet.

b. The lowar lip or beard.

14. Personate. Ex. *Antirrhinum*.

a. The palate.

b. The nectary.

15. Cruciform.

a. *b*. One of the petals separated, *a* its claw, *b* its border.

c. The stamens separated.

PLATE 14.

COROLLA CONTINUED.

Fig. 1. Papilionaceous or Butterfly-shaped flower. Ex. Sweet Pea. p. 52.

2. A dissection of the same.
   - *a.* The banner.
   - *b. b.* The wings.
   - *c.* The keel.

NECTARIES.

3. Spur-shaped Nectary of the Columbine, *Aquilegia.* p. 53.
4. Nectaries of the Monk's-hood, *Aconitum.*
5. Fringed Nectary of the *Parnassia.* p. 54.

PERICARPS.—p. 57.

6. Capsule of the Thorn-apple, *Datura Stramonium.* p. 57.
   - *a.* The cells.
   - *b.* The columns.
7. Silique. p. 58.
   - *a.* The dissepiment.
   - *b.* The valves.
8. Silicle.
9. Legume. p. 58.
10. Drupe. Ex. Cherry. p. 58.
11. Pome. Ex. Apple. p. 59.
12. Berry. Ex. Gooseberry. p. 59.
13. Compound berry. Ex. Blackberry. p. 59.
14. Strobile or Cone. p. 59.

PLATE 15. A.

CLASSES—*See Frontispiece.*

This plate contains a figure of a flower in each of the 24 Classes. With the exception of 1, 9, and 23, they are either native or commonly cultivated.

Fig. 1. Monandria, 1 stamen ; Mare's-tail, *Hippuris vulgaris.* Native of Britain.

This is an example also of the order *Monogynia*, having 1 pistil.

2. Diandria, 2 stamens ; Speedwell, *Veronica.*

3. Triandria, 3 stamens ; Common Timothy-grass or Herds-grass, *Phleum Pratense*, much magnified.

a. The entire Floret, having three stamens and two feathered styles projecting from the two compressed glumes which enclose them at the base.

b. The Pistil shown separate, consisting of the germen and two feathered styles.

This is an example also of the order *Digynia*, having 2 styles.

4. Tetrandria, 4 stamens ; Cornel, *Cornus paniculata*, somewhat magnified.

5. Pentandria, 5 stamens ; Common Elder, *Sambucus niger*, magnified.

It is an exemple also of the order *Tryginia*, having three sessile stigmas.

6. Hexandria, 6 stamens ; Barberry, *Berberis vulgaris.*

7. Heptandria, 7 stamens ; Chickweed winter-green, *Trientalis Europæus.*

8. Octandria, 8 stamens ; Dwarf tree primrose, *Œnothera pumila.*

9. Enneandria, 9 stamens ; Flowering Rush, *Butomus umbellatus.* Native of Britain.

This is also an example of the order *Hexagynia*, having 6 pistils.

10. Decandria, 10 stamens ; Broad-leaved Laurel or Lamb-kill, *Kalmia latifolia.*

11. Dodecandria, 12 to 19 stamens ; Houseleek, *Sempervivum tectorum.*

PLATE 15. CONTINUED.

12. Icosandria, 20 or more stamens *inserted into the calyx ;* Pear, *Pyrus communis.*

In this specimen the five stamens opposite the segments of the calyx are shorter than the rest.

B.

13. Polyandria, stamens more than 20, *inserted into the receptacle ;* Celandine, *Chelidonium majus.*

14. Didynamia, stamens 2 long and 2 short ; Selfheal, *Prunella Pennsylvanica.*

a. The flower.
b. The stamens and pistils shown separate and magnified.

In the genus Prunella the filaments are forked, and the anther borne on one point of the fork, as seen in the figure.

15. Tetradynamia, stamens 4 long and 2 short ; White Mustard, *Sinapis alba.*

a. The flower of the natural size.
b. The stamens and pistil magnified.
c. Glandular nectaries at the base of the stamens.
d. One of the petals.

16. Monadelphia, stamens united by their filaments into one tube ; Mallow, *Malva.*

a. The flower.
b. The stamens and pistil separated from the other parts of the flower.
c. The tube of the united filaments.
d. The anthers.
e. The styles passing through the tube and appearing at top like a pencil.

An example also of the order *Polyandria,* having many stamens.

PLATE 15. CONTINUED.

17. Diadelphia, stamens united into two parcels; Sweet Pea, *Lathyrus odoratus.*

a The flower.
b. The stamens and pistil separated from the other parts.

An example also of the order *Decandria,* having ten stamens.

In this as in many other papilionaceous flowers, there are nine stamens united by their filaments into one parcel and one stamen not united. This drawing was made from the dissection of a flower not quite expanded, in which the anthers were entire and consequently large.

Fig. 18. Polyadelphia, stamens united into more than two parcels; St. John's-wort. *Hypericum.*

An example also of the order *Polyandria,* having many stamens.

19. Syngenesia; stamens united by their anthers into a tube, flowers compound. A floret of the Dandelion, *Leontodon Taraxacum.*

A. The corolla.
B. The stamens.
c. The five separate filaments.
d The tube of united anthers.
E. The pistil.
f. The germen.
g. The style.
h. The stigma.
i. The pappus.

20 Gynandria, stamens united with, or growing out of the pistil; Ladies'-slipper, *Cypripedium acaule.*

a. The pistil.
b. The germen.
c. The style and stigma.
d. One of the anthers.
e. The pistil separated, having the anthers attached to the sides.

An example also of the order *Diandria,* having two stamens.

21. Monœcia, stamens and pistils in separate flowers on the same plant; Sedge-grass, *Carex cæspitosa.*

PLATE 15. CONTINUED.

A. The stamen-bearing spike.
b. One of the florets separated, consisting of a glume and 3 stamens.
C. The pistil-bearing spikes.
d. One of the florets separated, consisting of a pistil constituted of a germen, two styles, and a glume which protects them.

It is also an example of the order *Triandria*, having three stamens.

22. Diœcia, stamens and pistils in separate flowers on separate plants of the same species; Willow, *Salix*.

A. A stamen-bearing ament.
b. A floret separated, consisting of two stamens protected by a scale.
C. A pistil-bearing ament.
d. One of the florets separated, consisting of a pistil protected by a scale.

It is also an example of the order *Diandria*, having two stamens.

Fig. 23. Polygamia, stamens and pistils separate in some flowers, united in others, either on the same plant, or on two or three separate ones of the same species; Fig, *Ficus*.

a. A stamen-bearing flower.
b. A pistil-bearing flower.
c. A perfect flower.

It is likewise an example of the order *Triœcia*, the three kinds of flowers being on three different trees.

24. Cryptogamia, stamens and pistils obscure.

A. A a Fern, Polypod, *Polypodium vulgaris*.
b. The patches of fructification.
C. Hair-cap Moss, *Polytrichum*.
D. Scarlet Lichen, *Lichen cocineus*.

The above are examples of three of the orders of Cryptogamia, viz. Filices, Musci, and Hepaticæ.

Several of the 24 classes of Linnæus have been abandoned by several eminent botanists. The classes Polyadelphia and Polygamia particularly have been rejected, and the plants distributed in other classes. These are rejected in Eaton's "Manual," which is consequently arranged under 22 classes.

PLATE 16.

COMPOUND FLOWERS.—p. 70.

Fig. 1. A compound radiate Flower. Field Daisy.

a. The ray or external circle of florets.
b. The disk or centre.
c. A ligulate floret of the ray separated.
d. A tubular floret of the disk separated.

2. A ligulate Flower. Dandelion.

a. One of the florets separated.

3. A Discoid flower. Burdock.

a. A floret separated.

SEEDS.

4. A Seed and its appendages.

a. The seed.
b. The stipe.
c. The pappus or down. p. 60.

5. The wing of a seed. p. 61
6. A seed having one cotyledon. p. 60.
7. A seed having two cotyledons. p. 60.

a. a. The cotyledons.
b. c. The corcule.
b. The radicle, and
e. The plume.

8. A seed having many cotyledons. p. 60.
9. Seminal leaves. p. 60.
10. Anatomy of wood. p. 104.

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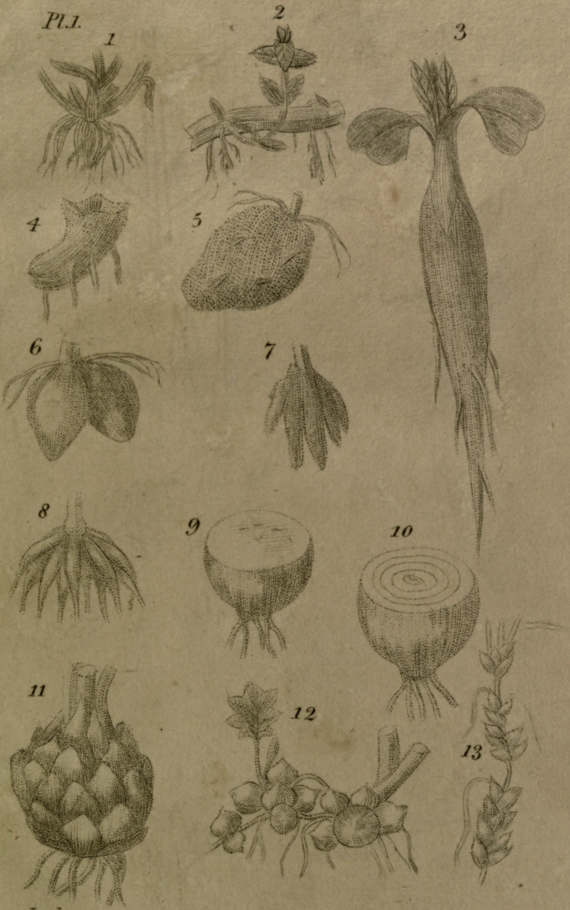
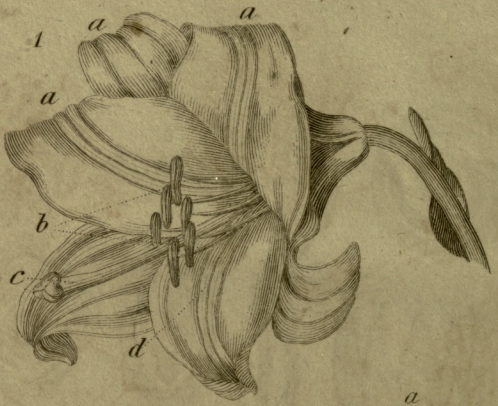


Locke sc.

Plate 2.

Plate 3.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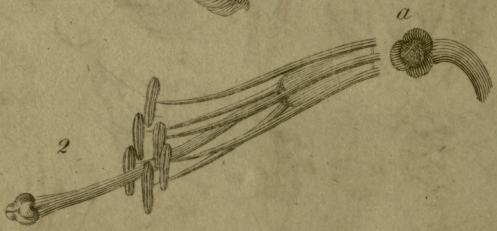
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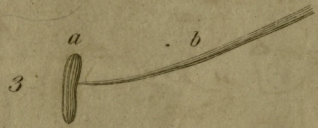
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b
3


c
b
a
4

Pl. 13